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## ABSTRACT

This instructor's guide contains the materials required to teach a competency-based introductory course in roofing to students who have chosen to explore careers in construction. The following topics are covered in the course's three instructional units: roofing materials, roofing tools, and applied skills. Each unit contains some or all of the following: objective sheets, suggested activities, supplemental information/activities to be presented at the instructor's discretion, information sheets, sheets of supplementary information to assist students in solving problems, transparency masters, instructional supplements containing suggestions for teaching basic skills, assignment sheets, job sheets, practical tests, written tests, and answers to assignment sheets and tests. Academic skills training is combined with vocational training throughout the instructional materials, and a system of icons has been used to help instructors identify activities into which training in the following basic skill areas has been infused: reading, science, creative thinking/problem solving, writing, oral communication, employability, math, interpersonal skills, and social studies. Most units of instruction are designed for use in more than one lesson or class period of instruction. These materials precede the instructional units: information on basic skills in curriculum, information on measuring student performance gains, and required criteria for a competency-based education program. A competency profile and basic skills matrix are included. (MN)

ED 385 692

# introduction to construction series

## introduction to roofing

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instructor edition

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# Introduction To Roofing

Developed as a Cooperative Project by  
the Associated General Contractors of America  
Steve L. Hoech, Chairman, Workforce Development Committee  
and  
Curriculum and Instructional Materials Center,  
Oklahoma Department of Vocational and Technical Education

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## Introduction To Roofing

### TABLE OF CONTENTS

A1- Roofing Materials  
A2- Roofing Tools  
A3- Applied Skills

## FOREWORD

In 1985, The Associated General Contractors of America (AGC) met with representatives of the Oklahoma Curriculum and Instructional Materials Center (CIMC) to discuss the possibilities of developing, as a cooperative project a course of instruction designed for training individuals who choose to seriously explore careers in construction.

This publication is the result of those original discussions and updates made through close coordination among general contractors and vocational educators. This series represents conscious effort to coordinate the practical experience of personnel in the carpentry industry with the best instructional methods of those in the field of vocational education.

Although this book reflects a systematic approach to instructional materials development and the latest in educational technology innovations, the information in the *Introduction To Roofing* manual should be adapted and modified to coincide with local conditions.

Roy Peters, Jr.  
State Director  
Oklahoma Department of Vocational  
and Technical Education

Steve L. Hoech, Chairman  
Workforce Development Committee  
The Associated General Contractors  
of America

## PREFACE

Construction requires that students have many skills and related information to become productive workers in this challenging field. Workers must be better trained and equipped to find and retain meaningful employment.

Instructional materials in this manual is written in terms of student performance, using measurable behavioral learning process. Criterion-referenced evaluation instrument provide for a uniform measurement of student progress.

The purpose of this manual is to assist instructors in all construction related areas in providing instruction throughout the industry. Any information in this manual that does not concur with the instructor's course of study should be modified to meet personal needs.

Personnel safety is of prime concern, as an instructor you are encouraged to closely observe and couch students in all safety issues. We have done much to advise students of possible dangers, but your close supervision and alertness can't be overemphasized.

Al Willey  
Curriculum and Instructional Materials Center  
Oklahoma Department of Vocational  
and Technical Education

## ACKNOWLEDGEMENTS

Much appreciation is expressed to the many individuals who contributed their time, talents, and knowledge in the revision of this manual.

Thank you to the following ad hoc committee members, AGC staff representatives, and the staff of the Oklahoma Department of Vocational and Technical Education.

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## USE OF THIS PUBLICATION INSTRUCTIONAL UNIT

**Introduction To Roofing** contains three units. Each instructional unit includes some or all of the basic components of a unit of instruction: performance objectives, suggested activities for the instructor, extensions and options, information sheets, student supplements, transparency masters, instructional supplements, assignment sheets, job sheets, practical tests, written test, and answers to assignment sheets and written test, all of which are included in the instructor's edition. The student workbook includes the objective sheets, information sheets, student supplements, transparency masters, assignment sheets, and job sheets. Written tests may be duplicated for classroom use or *additional copies* may be purchased by calling 1-800-654-4502 or, in Oklahoma, 1-800-522-5810, ext. 589.

All of the unit components tie into measurable and observable learning outcomes. Instructors are encouraged to supplement these components with other resources in order to make them as responsive to local conditions and individual needs as possible.

Most units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the instructor will help him or her determine the following:

- Amount of material that can be covered in each class period.
- Skills that must be demonstrated.
  - Supplies and equipment needed
  - Amount of class time needed for demonstrations
  - Amount of time needed for student practice
- Supplementary materials, including print and non-print media, that must be ordered.
- Resource people who must be contacted.

### Objective Sheet

Each unit of instruction is based on the performance needed for successful employment in an occupational area. Performance objectives are stated in two forms. The unit objectives states the overall goal of the unit. It tells what the student should be able to do and what standard will be used to see whether the student can do it. Specific objectives outline the teaching sequence of the competencies required to meet the unit objective.

The objectives should be provided for students and stressed throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Instructors should prepare for each unit by deciding how each objective could be best taught.

Instructors should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When objectives are added, the instructor should remember to supply the needed information, assignment and/or job sheets, and criterion-referenced test items.

### **Suggested Activities — Instructor's Edition only**

The suggested activities page assists the instructor during the preparation stage of the teaching/learning process by providing suggestions for delivery, application, and evaluation during the instructional process. The instructor should read the suggested activities prior to introducing the unit to allow time to obtain supplemental materials, prepare audiovisual materials, and contact outside resources. Duties of the instructor will vary according to the particular unit.

References used in the development of each unit are listed in the "Suggested Resources" section, along with print and non-print media that may be used to teach the unit. These materials can be used by the instructor to supplement his or her knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

### **Extensions and Options — Instructor's Edition only**

Extensions and Options are supplemental material that is not testable or graded and is nice-to-know. Extensions and Options provide the instructor with additional activities, fact sheets, art, controversial items, and extra practice sheets. They may also include items for the gifted or remedial student. Extensions and Options are used at the discretion of the instructor.

### **Information Sheets**

The information sheet provides "must know" content essential for meeting the cognitive objectives stated at the beginning of each unit. It serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective.

Students should read the information sheet before it is discussed in class. Space is provided in margins for students and instructors to add notes that clarify and/or expand on the information provided.

The information sheet may include notes, cautions, or warnings. These should be discussed carefully and thoroughly. **Notes** are short verbal additions to the information sheet or procedural outline that provide nice-to-know and decision-making information. A note may tell the student what to watch for or to consider at a given step. It may explain when a step may not be applicable. Notes offer guidance that may help the student understand the process and do it more efficiently. **Cautions** are advisories that tell the student how to avoid causing minor personal injury or equipment damage. **Warnings** are advisories to the student used to avoid serious personal injury or death to the student, persons in the workplace, or users of the project or the procedure.



## **Student Supplement**

Student supplements include instructions that could be used for solving problems or reinforcing the enrichment of learning. The information presented in a student supplement may consist of tables, charts, written information, forms, or other information students will need in order to complete one or more of the assignment or job sheets. While supplements are not tested over directly, they may be used to assist in meeting the performance objectives.

## **Transparency Masters — Instructor's Edition only**

Transparency masters provide information in a special way. The students may see as well as hear the materials being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information or assignment sheets.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. They should be left on the screen only when topics shown are under discussion.

## **Instructional Supplements — Instructor's Edition only**

Instructional Supplements provide suggestions for teaching the basic skills included in each assignment sheet or job sheet. They are located directly in front of the components they support—assignment or job sheets—in each unit.

## **Assignment Sheets**

Assignment sheets provide students with information and exercises that address learning levels at or above the application level of Bloom's taxonomy. Assignment sheets provide written exercises for instruction and practice of a specific objective. The introduction to the assignment sheet explains how the assignment sheet relates to the subject area and unit component for such information.

### **Assignment Sheet Answers — Instructor's Edition only**

This component is designed to assist the instructor in evaluating student performance on assignment sheets.

### **Job Sheet**

Job Sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomotor skill. They describe a step-by-step procedure to complete each task or job. Diagrams, photographs, and illustration are provided to assist students in achieving the skill.

The instructor should demonstrate the procedure outlined in each job sheet. Furthermore, the instructor needs to localize the procedure according to the equipment and supplies available in the local lab or salon situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

### **Practical Tests — Instructor's Edition only**

The practical tests are designed to assist the instructor in the evaluation of the psychomotor activities (job sheets). The practical test provides instructors with a valid mechanism for determining a student's level of ability in performing the procedure stated on the job sheet. The check-off list allows instructors to evaluate a student's process performance of the task on the job sheet. The overall competency indicator allows the instructor to evaluate the end product.

### **Written Test — Instructor's Edition only**

This component provides criterion-referenced evaluation of every objective listed in the unit of instruction. If objectives have been added, deleted, or modified, appropriate changes should be made on the test.

In order to measure and document student competency gains as required by the latest Carl Perkins regulations, and as outlined in the Oklahoma-developed system of standards and measures, it is *absolutely essential* that the same test be used as a pretest and as a posttest. If you choose to use tests other than the ones included herein, be sure that the same instrument is used for each activity—pre- and post test.

A detailed explanation of the Oklahoma plan for standards and measures and the Carl Perkins requirements is included in the CIMC publication, *Measuring Learning & Competency Gain: The Pretest/Posttest Approach*. This booklet and accompanying software designed to assist in calculating and recording student gains are available to all vocational teachers through the school's vocational testing liaison.

To further assist vocational teachers, the CIMC is in the process of developing test code sheets for each written test in its more recent publications, including this one. These code sheets are explained in Section 8 of the publication mentioned above, and will greatly assist in verifying that the test is a valid instrument for measuring student learning and competency gains.

#### **Written Test Answers — Instructor's Edition only**

This component is designed to assist the instructor in evaluating student performance on written tests.

#### **COMPETENCY PROFILES**

A competency profile is in the front of each publication. Competency profiles document student performance. The profile contains a list of the specific job competencies that a student should achieve before leaving the training program.

#### **PAGE NUMBERING**

Each publication for the Curriculum and Instructional Materials Center is usually assigned a specific abbreviation. *Introduction To Roofing* has not been abbreviated. Each unit will be recognized by the unit number in Arabic numerals. Each unit in the publication begins with page 1. Each page number gives the component name, Introduction To Roofing, unit number, and page number within the unit. Since some CIMC publications are loose-leaf, this system of page numbering was recently adopted so that pages from different manuals would not get mixed up. The page number for the objective sheet in *Introduction To Roofing*, which is Unit 2, would look like this:

OBJECTIVE SHEET - Introduction To Roofing  
CIMC - A2 - 1

#### **METHODS OF DISSEMINATING MATERIAL**

For best results, provide student materials for each student. Student workbooks contain objective sheets, information sheets, supplements, transparency masters, assignment sheets, and job sheets. Pretest, practical tests, and written tests are packaged separately for students, and can be stored until needed. Students should be allowed to take their materials home at the end of the course.

## TEACHING METHODS

Keeping students motivated is a challenge. Supplement the objectives by providing the "why," personal experiences, and current information. If you are going to teach the material in a group setting, prepare for the unit by deciding the best way to teach each objective and allow for student input.

If you are going to follow the plan for individualized instruction, provide opportunities that will allow each student to become involved in planning for and being responsible for his or her own education.

### CORRECTIONS AND SUGGESTIONS

The Curriculum and Instructional Materials Center (CIMC) wants to provide vocational instructors and students with materials that are accurate and effective. Although the CIMC strives to maintain the highest standards of development and production, oversights occasionally do occur. If you find any errors in this or other CIMC publications, or have suggestions for improving their usefulness in vocational programs, please notify the CIMC staff. One easy way of pointing out errors is to make a photocopy of the affected page and to indicate the correction on the copy. Mail this information to the CIMC, where it will be used to correct the publication before the materials are reprinted.

To ensure that the material is updated on a timely basis, notify the CIMC of necessary corrections as soon as possible after discovering the error. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

Coordinator of Development  
Curriculum and Instructional Materials Center  
Oklahoma Department of Vocational and  
Technical Education  
1500 West Seventh Avenue  
Stillwater, Oklahoma 74074-4364

**For a free catalog, a list of new publications,  
or other instructional materials information call  
1-800-522-5810, extension 589.**



## BASIC SKILLS IN CURRICULUM

The CIMC has always been mindful of the importance of reinforcement (and sometimes remediation) of students' academic skills as they progress through vocational training, and has always included activities in its materials to enhance and promote use of these skills.

Recent state and federal legislation mandates vigorous basic skills development in vocational education in the wake of demands by industry that workers *must* be academically, as well as technically, competent, given the nature of the highly complex work place. In response, the CIMC has taken the following steps to document that, indeed, the instructional materials *do* combine academic skills training with the vocational training. In addition, concerted efforts have been made to "beef up," or enhance the basic skills instruction already present. Following is a brief description of those processes:

### ***Basic Skills Icons and Enablers***

To assist teachers and students in identifying activities that promote basic skills development, the CIMC has implemented a marking system that uses simple graphic symbols, or icons, and a list of specific tasks, or enablers, to identify the basic skill or skills that are called for in each job or assignment sheet.

Each of the nine broad skills areas—reading, writing, mathematics, science, oral communication, interpersonal or relating, creative thinking and problem solving, employability, and social studies—is represented by the icon presented below.



Reading



Science



Creative Thinking/  
Problem Solving



Writing



Oral Communication



Employability



Math



Interpersonal or Relating



Social Studies



When an activity involving one of these basic skills is identified, the corresponding icon is placed in the left-hand margin of the job or assignment sheet. The basic skills training is further defined by retrieving the specific, or enabling, skill that is required by consulting a list of over two hundred and fifty enablers that has been compiled and grouped with each general basic skill. This enabling skill is placed directly below the icon.

As an example, an exercise that requires a student to conduct library research would make necessary the use of specific reading comprehension and research and reference skills. The basic skills that the exercise promotes would be depicted in the left-hand margin as follows:

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>ASSIGNMENT<br/>SHEET</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>PLANNING LIVING<br/>SPACE FOR HUMAN NEEDS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>1</b> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Name _____ Score _____                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |
| <b>OBJECTIVE 10</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Define personal territory.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          |
| <b>INSTRUCTIONS</b><br><br><br><u>Reading Comprehension</u><br>• Gain factual information<br><u>Functional Reading</u><br>• Follow written instructions<br>• Use content area vocabulary<br><br><br><u>Language</u><br>• Use standard grammar, spelling, and capitalization<br>• State ideas clearly | <ul style="list-style-type: none"> <li>• As discussed in Objective 1, each person has an invisible "space bubble" or comfort zone. A comfort zone is the space between oneself and others that brings a feeling of well-being. When one's comfort zone is crowded or invaded, discomfort often results. Therefore, personal territory needs should be a prime consideration when planning living space.</li> <li>• For each of the following situations, draw your estimated comfort zone around the figures provided.</li> <li>• Indicate how many inches from your body the comfort zone extends.</li> <li>• Consider how that comfort zone changes in different situations. Answer the questions that follow.</li> </ul> |          |



### ***Basic Skills Documentation Matrix***

Another component of the CIMC basic skills instructional plan is the "Basic Skills Documentation Matrix." The matrix graphically summarizes the basic skills training included in the vocational program, unit by unit. It should be helpful to teachers in planning their instruction, and to administrators as documentation that basic skills are being addressed during the vocational training.

The matrix for this publication is included as an 8½" by 11" foldout in this *Instructor's Manual*.

Matrices have been developed for most CIMC publications. For more information on those available for other programs, call the CIMC at 1-800-654-4502.

### ***Instructional Supplement***

The supplement is a tool for the instructor to use in helping students apply the basic skills in Assignment Sheets and Job Sheets. Some supplements are appropriate for use with all students; some are for use only with those students who do not understand the academic skills called for in the exercise.

## MEASURING STUDENT PERFORMANCE GAINS

When you examine this book, you will notice that separate written pretests are no longer included in the units of instruction. Each CIMC unit now contains only a single Written Test. This test should be used as **both** pretest and posttest by giving it once before students start a unit and again when they have completed the unit.

The reason for using a single instrument as both pretest and posttest is so that direct comparison of each student's competencies before and after instruction can be made accurately. This comparison enables precise calculation, documentation, and evaluation of student **performance gains**.

Accurate performance gains analysis is an important requirement of the new Carl Perkins legislation for vocational education. Teachers can make an important contribution to the performance accountability mandated by the new federal legislation by carrying out accurate performance gains analysis for their students, and making this data available to students, parents, and administrators.

This analysis is easy to do and requires only simple calculations and record keeping. Detailed information regarding performance gains analysis is contained in the CIMC publication, *Measuring Learning & Competency Gains: The Pretest/Posttest Approach*. In addition, the CIMC has developed a computer program, CARL, which will perform all necessary calculations and will print out a record form of all information required for gain score analysis. Copies of CARL and the publication are available through your local testing liaison (in Oklahoma), or from the CIMC at 1-800-654-4502.

# REQUIRED CRITERIA FOR A COMPETENCY-BASED EDUCATION PROGRAM

| Criterion                                                                                                                                                                   | Discussion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CIMC component meeting criterion      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| 1. Instruction is based on clearly-stated learning objectives that are: a) observable and measurable, and b) communicated in writing to students before instruction begins. | Learning objectives drive CBE. Objectives are the "competencies" that learners must achieve. Each objective must clearly state what <i>learners</i> must <i>do</i> to demonstrate acquired skill or knowledge. Verbs in learning objectives are active and precise, stating the exact performance expected of learners. The objectives should also specify the standard or level of performance required. Objectives can be at any level of Bloom's Taxonomy and can include the cognitive, psychomotor, and affective domains. Higher-order cognitive skills should be included.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Objective Sheet                       |
| 2. Instruction is aligned with the stated learning objectives                                                                                                               | In CBE, the objectives specify what is taught. "Content" should relate to one or more objectives. The curriculum should cover all objectives with relevant information.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Information Sheet                     |
| 3. There is a student evaluation system that is: a) criterion-referenced, and b) aligned to the learning objectives and the curriculum.                                     | <p>In CBE, the aim is to bring the performance of <i>all</i> learners up to a pre-defined standards and competencies. Learners work on each competency until they achieve "mastery"; the evaluation system should test and record this mastery. Learners can restudy and retest as often as needed. Specific remediation activities should also be available to learners when needed. The evaluation system focuses on what each student has achieved, not on what the instructor has "taught." The "constant" in CBE is student performance; the "variables" are time and resources. (This differs from traditional systems where learners get one chance at mastery; some succeed and some fail. In such systems, time and resources are constant and student achievement is variable.)</p> <p>If an evaluation is criterion-referenced, successful learner performance is defined by (or <i>referenced</i> to) mastery of pre-set objectives and standards (or <i>criteria</i>); there must be a careful match (or <i>alignment</i>) between what the student should master (objectives), what is taught (curriculum), and what is tested. Objectives, curriculum, and evaluation system must all match.</p> | Written Test and Job Sheet/Skill Test |

| Criterion                                                                                                                                               | Discussion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CIMC component meeting criterion |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 4. There is an observable management system of cognitive skill practice that provides for, promotes, and documents mastery learning.                    | <p>For both cognitive and psychomotor skills, a CBE program must have a system of maintaining records of which skills and activities each learner has completed, which ones are in progress, and which ones have not yet been completed. Completion means "mastery"; no skill is completed until the learner has achieved the mastery level.</p> <p>The record system should promote feedback on student skill attainment to <i>both</i> instructor and learners, provide for remediation as needed, and encourage reevaluation of learner performance until mastery is achieved. Appropriate remediation strategies often should consider learning styles and other individual differences among learners.</p> | Assignment Sheet                 |
| 5. There is an observable management system of psychomotor skill practice that provides for, promotes, and documents mastery learning.                  | <p>Learners should work on skills and activities until they achieve mastery. They should not be "passed on" without mastery. While learners may move ahead and work on other skills (i.e. those for which all prerequisite skills have been mastered or those without prerequisites), work should also continue on the skills still requiring mastery. Students should not attempt higher-order skills until all prerequisite skills are mastered.</p>                                                                                                                                                                                                                                                          | Job Sheet/Skill Test             |
| 6. Skill mastery records are maintained for each learner, and learners have access to and make use of these records to monitor their skill acquisition. | <p>Records should clearly indicate the skills each learner has mastered. One such record should profile or list the competencies that have been mastered and those to be mastered. Other performance indicators can be added and kept in a portfolio for each learner. Learners should have ready access to their portfolios to monitor their own progress in skill mastery and competency attainment.</p>                                                                                                                                                                                                                                                                                                      | Competency Profile               |

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This information will be used to correct the publication before the materials are reprinted. To ensure that the material is updated on a timely basis, notify the CIMC of necessary corrections as soon as possible after discovering the error.

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| OBJECTIVE<br>SHEET     | ROOFING MATERIALS <span style="float: right;">A 1</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| INTRODUCTION           | <p>Roofing is used to protect structures from the effects of weather.</p> <p>The materials described are those used in residential and light commercial roofing applications. Materials such as decking, underlayment, shingles, vents/louvers, drip strips, caps, flashing, and fasteners are discussed.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| PREREQUISITE           | <p><i>Fundamentals of Construction</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| UNIT<br>OBJECTIVE      | <p>After completing this unit, the student will be able to define terms and identify roofing materials. The student will demonstrate these competencies by completing the assignment sheet and written test with a minimum of 85 percent accuracy.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| SPECIFIC<br>OBJECTIVES | <p>After completing this unit, the student will be able to show the ability to:</p> <ol style="list-style-type: none"> <li>1. Given a list of terms associated with roofing materials, match them to their correct definitions.</li> <li>2. Given drawings, identify common roof designs.</li> <li>3. Identify the parts of a roof.</li> <li>4. Given drawings, identify basic types of shingles, underlayment, drip strips, caps, louvers and vents.</li> <li>5. Provided drawings, match roofing fasteners to their names.</li> <li>6. Identify materials used on commercial buildings that utilize built-up roofing methods.</li> <li>7. Name the purpose and material types used for flashing.</li> <li>8. Estimate the material required to install a three-tab asphalt-shingle roof. (Assignment Sheet 1)</li> </ol> |



**SUGGESTED  
ACTIVITIES**

**ROOFING MATERIALS**

**A 1**

**PREPARATION**

- Review unit and plan presentation.
- Order or obtain materials to supplement unit.
- Introduce unit.

**DELIVERY**

**Objective 1: Given a list of terms associated with roofing materials, match them to their correct definitions.**

- Discuss terms and definitions associated with roofing material.
- Show the class actual samples of materials when appropriate.
- Explain how knowing the term and definitions will help the student understand and grasp the importance of this unit.

**Objective 2: Given drawings, identify common roof designs.**

- Discuss types of traditional roof designs.
- Take the class to visit sites where the various designs can be seen; if at all possible, inspect the roofs to study the roofing installations; point out special requirements for flashing and other materials as well as special installation techniques.
- Emphasize roof designs common in your area.
- Provide students with roofing specifications from plans for the various roof designs.

**Objective 3: Identify the parts of a roof.**

- Use Transparency 1 to discuss parts of a roof, emphasizing parts not covered in roof framing and the relation of each part to the installation of roofing.

**Objective 4: Given drawings, identify basic types of shingles, underlayment, drip strips, caps, louvers and vents.**

- Show the class examples of each type of shingle and the manufacturer's instructions for each type.

**NOTE:** Discuss differences in materials, color variations, size variations, and self-sealing designs among manufacturers. Also emphasize variations between lot runs for a single manufacturer.

- Show the class samples of the different types of underlayment and explain their uses.
- Show various types of drip strips and explain their purposes.
- Describe the use of caps.
- Discuss the purpose of louvers/vents. Explain that their proper use can increase the efficiency of an air conditioner by 20 to 30%.

**Objective 5: Provided drawings, match roofing fasteners to their names.**

- Use Transparencies 2-4 to describe fasteners.
- Show class examples of roofing fasteners. Explain that electric and pneumatic staple and nail guns are becoming increasingly popular in applying roofing.

**Objective 6: Identify materials used on commercial buildings that utilize built-up roofing methods.**

- Discuss the layers of materials used on built-up roofing.
- Arrange for students to visit a construction site to observe the roofing of a commercial building.
- Use Transparency 5 to discuss built-up roofing.



**Objective 7: Name the purpose and material types used for flashing.**

- Discuss the purpose and types of materials used for flashing.
- Show the class samples of the various materials used for flashing.
- Show the class different styles of flashing and discuss the various widths of roll flashing available; provide samples of flashing materials other than roll flashing.

**APPLICATION**

**Objective 7: Estimate the material required to install a three-tab asphalt-shingle roof. (Assignment Sheet)**

- Review the examples of material estimating provided by the Information Sheet.
- Allow students to practice the procedures in the assignment sheet.

**EVALUATION**

**Pretest**

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

**Skill Test**

- Evaluate students on assignment sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.



- Modify materials in unit or create supplementary materials for individual students as required.

#### Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give the written test.

**NOTE:** The written test may be given in sections if desired.

- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

#### UNIT REFERENCES

- Toenjes, Leonard P. *Building Trades Dictionary*. American Technical Publishers, Inc.: Homewood, IL.
- Willey, Al. *Residential Carpentry*. Oklahoma Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America: Stillwater, OK.



**OBJECTIVE 1**

Given a list of terms associated with roofing materials, match them to their correct definitions.

- **aggregate surface** — see mineral surface
- **asphalt roof cement** — special cement designed to hold roofing felts and wall flashing in place
- **base sheet** — the first or lowest layer of asphalt-saturated and coated composition roofing used in built-up roofing
- **built-up roof** — roof with several layers of felt that are saturated with coal tar, pitch, or asphalt with a topping of aggregate
- **butt edge** — bottom edge of shingle
- **cap sheets** — the top-most granule-surfaced coated sheet used in built-up roofs
- **cutout (waterchannel)** — slot or opening in tab shingle
- **decking** — material used to form a roof such as plywood, lumber, or sheet metal
- **drip edge** — edge of roof from which water drips into gutter or into the open
- **exposure** — portion of shingle that is subjected to weathering
- **flashing** — material (usually sheetmetal) used to prevent rain or other moisture from entering structure
- **flutes or ribs** — depressions in the surface of steel roof decks to improve their strength and rigidity
- **mineral surface** — rock granules that cover asphalt-coated composition roofing



- **parapet** — low wall extending above a horizontal surface
- **ply-clip** — metal fasteners that are used to secure plywood edges; they are shaped in an "H" to allow adjoining plywood decking to be held in place
- **plysheet** — a sheet of felt used as one layer of a built-up roof
- **plywood** — a wood product made up of several layers of veneer that are glued together; plywood sheets measuring 4' x 8' (other sizes available) are often used as roof decking material.
- **R-value or R-factor** — an industry standard used to define insulation effectiveness
- **roof vents** — protected openings in a roof that reduce attic heat and moisture levels; several types are available including turbines, ridge vents, and soffit vents
- **slope** — incline of roof as a ratio of vertical rise to horizontal run

**EXAMPLE:** If the roof rises at the rate of 4 inches for each foot of run, it is designated as having a 4 in 12 slope

- **spaced deck sheathing** — 1x boards that are nailed to rafters with spacings equal to width of boards
- **square** — amount of roofing material needed to provide 100 square feet of finished roofing
- **starter row** — the lowest row of shingles that are positioned to strengthen and cover the roof; the lowest row of shingles could leave exposed underlayment without the starter row installed.
- **torch down** — a roofing method in which asphalt layers are heated with a torch as they are rolled into place





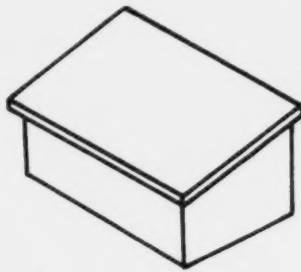
- **underwriter's listing** — a listing of material specifications such as for shingles; the listing provides standards such as shingle size, thickness, and fire retardant properties (A, B, or C classification).
- **wood shakes** — shingles split from cedar bolts and shaped for use as roofing

## OBJECTIVE 2

Given drawings, identify common roof designs.

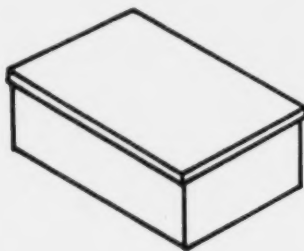
- **Shed** — a roof that slopes in only one direction

FIGURE 1



- **Flat** — a roof that is pitched only enough to provide drainage

FIGURE 2

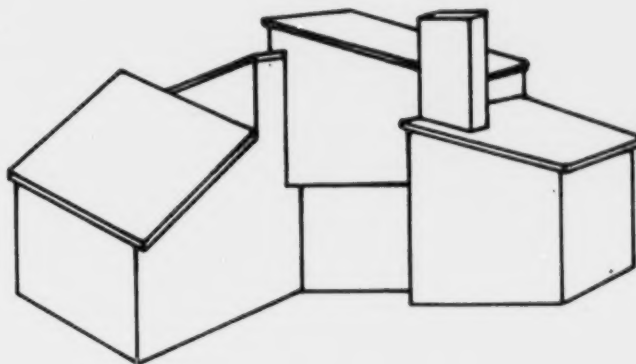


**NOTE:** Even flat roofs should have a pitch not less than  $\frac{1}{4}$ ".



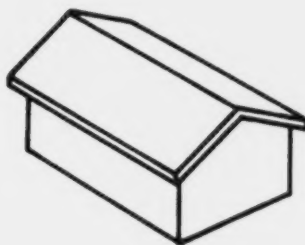
- Monopitched — a roof that has a series of shed roofs that may slope in several directions

**FIGURE 3**



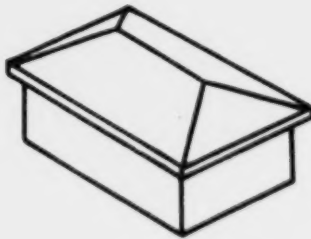
- Gable — a double-sloping roof that forms a gable at each end

**FIGURE 4**



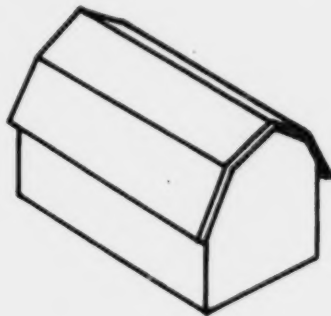
- Hip — a roof that has sloping ends and sloping sides

**FIGURE 5**



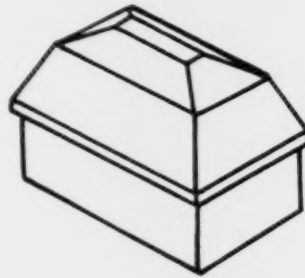
- Gambrel — a roof with two slopes; a lower steeper slope and an upper flatter slope

**FIGURE 6**



- Mansard — a roof, like a gambrel roof, that has two slopes but the ends also slope

FIGURE 7

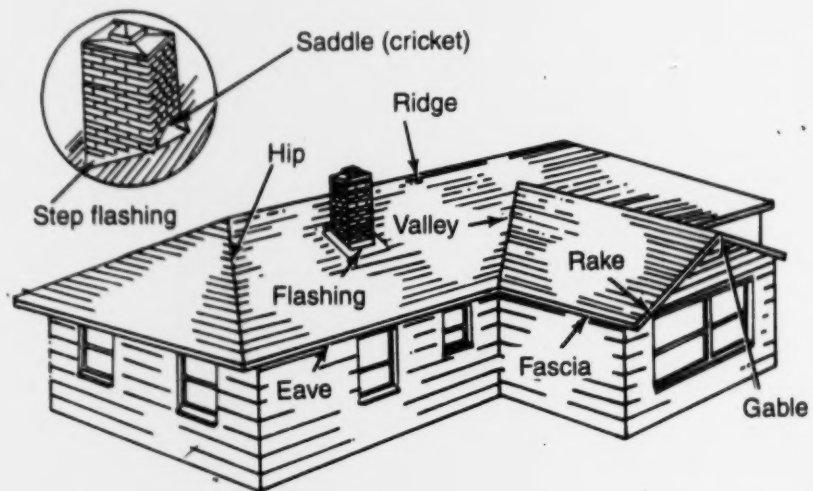


OBJECTIVE 3

Identify the parts of a roof.

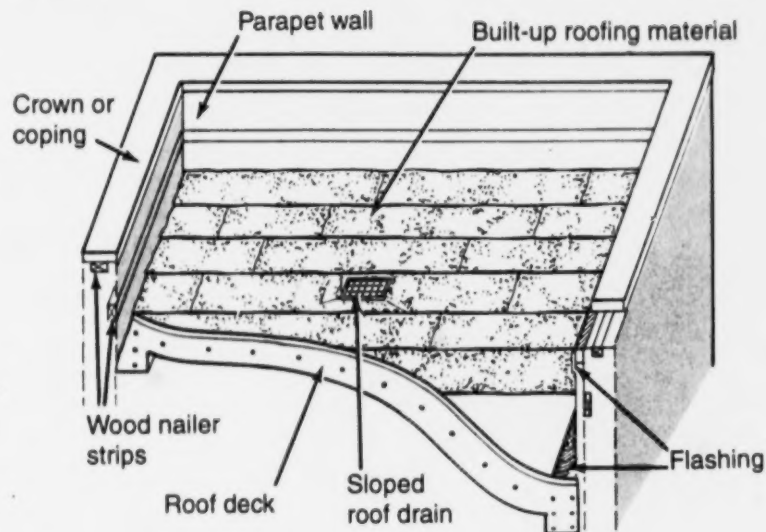
- Residential

FIGURE 8



- Commercial

**FIGURE 9**



**OBJECTIVE 4**

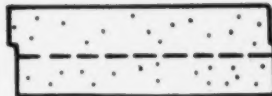
Given drawings, identify basic types of shingles, underlayment, drip strips, caps, and vents and louvers.

- asphalt shingles

**NOTE:** A modern strip shingle is normally impregnated with a sealant that holds down the tab of the course that has been laid over the shingle. The black dashes across the middles of the shingles illustrated below represent this self-sealing strip.

— Strip shingle without tabs

**FIGURE 10**



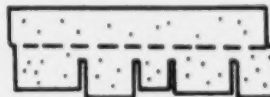
- Strip shingle with tabs

FIGURE 11



- Wood-appearance strip single with single thickness per strip

FIGURE 12



- Wood-appearance strip shingle with more than one thickness per strip

FIGURE 13



TABLE 1:

## BASIC TYPES OF ASPHALT SHINGLES

| Product                                | Approximate<br>Shipping<br>Weight    | Per Square |         | Size<br>(Inches) |           | Exposure | Underwriters'<br>Listing           |
|----------------------------------------|--------------------------------------|------------|---------|------------------|-----------|----------|------------------------------------|
|                                        |                                      | Shingles   | Bundles | Width            | Length    |          |                                    |
| Strip shingle without<br>tabs          | Various                              | 78         | 3       | 12"              | 36"       | 5"       | A or C—<br>all wind-<br>resistant  |
|                                        | 215 lbs                              | to         | or      | or               | or        |          |                                    |
|                                        | to<br>290 lbs                        | 81         | 4       | 12¼"             | 36¼"      |          |                                    |
| Strip shingle<br>with tabs             | 205 lbs                              | 78         | 3       | 12"              | 36"       | 5"       |                                    |
|                                        | to                                   | or         | or      | or               |           | or       |                                    |
|                                        | 240 lbs                              | 80         | 4       | 12¼"             |           | 5¼"      |                                    |
| Strip shingle<br>(single<br>thickness) | Various,<br>215 lbs<br>to<br>325 lbs |            |         |                  |           |          | A or C—<br>many wind-<br>resistant |
|                                        | 285 lbs                              | 67         | 4       | 11½"             | 36"       | 4"       |                                    |
|                                        | to<br>390 lbs                        | to<br>90   | or<br>5 | to<br>15"        | or<br>40" | to<br>6" |                                    |
| Strip shingle<br>(double<br>thickness) | Various,<br>250 lbs<br>to<br>350 lbs |            |         |                  |           |          | A or C—<br>many wind-<br>resistant |
|                                        | 250 lbs                              | to         | or      | or               | or        | to       |                                    |
|                                        | to<br>350 lbs                        | 90         | 4       | 12¼"             | 40"       | 5¼"      |                                    |

**NOTE:** There are other types of shingles such as those composed of plastics and fiberglass material available on the market.



- Wood shingles/shakes

— Shake

**FIGURE 14**



— Shingle

**FIGURE 15**



**NOTE:** Shakes and shingles come in various widths and lengths.





**TABLE 2: STANDARDS FOR WOOD SHINGLES**

| Grade | Length            | Thickness<br>(at Butt) | No. of<br>Courses<br>Per Bundle | Bdls/Cartons<br>per Square | Description                                                                                                                                                                                                        |
|-------|-------------------|------------------------|---------------------------------|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| No. 1 | 16" (Fivex)       | .40"                   | 20                              | 4 bdls                     | The premium grade of shingles for roofs and sidewalls.                                                                                                                                                             |
|       | 18" (Perfections) | .45"                   | 18                              | 4 bdls                     |                                                                                                                                                                                                                    |
|       | 24" (Royals)      | .50"                   | 13                              | 4 bdls                     |                                                                                                                                                                                                                    |
| No. 2 | 16" (Fivex)       | .40"                   | 20                              | 4 bdls                     | A good grade for many applications.                                                                                                                                                                                |
|       | 18" (Perfections) | .45"                   | 18                              | 4 bdls                     |                                                                                                                                                                                                                    |
|       | 24" (Royals)      | .50"                   | 13                              | 4 bdls                     |                                                                                                                                                                                                                    |
| No. 3 | 16" (Fivex)       | .40"                   | 20                              | 4 bdls                     | A utility grade for economy applications and secondary building.                                                                                                                                                   |
|       | 18" (Perfections) | .45"                   | 18                              | 4 bdls                     |                                                                                                                                                                                                                    |
|       | 24" (Royals)      | .50"                   | 13                              | 4 bdls                     |                                                                                                                                                                                                                    |
| No. 4 | 16" (Fivex)       | .40"                   | 14 or                           | 2 bdls                     | A utility grade for undercoursing on double-coursed sidewall applications or for interior accent walls                                                                                                             |
|       |                   |                        | 20                              | 2 bdls                     |                                                                                                                                                                                                                    |
|       | 18" (Perfections) | .45"                   | 14 or                           | 2 bdls                     |                                                                                                                                                                                                                    |
|       |                   |                        | 18                              | 2 bdls                     |                                                                                                                                                                                                                    |
| No. 1 | 16" (Fivex)       | .40"                   | 33                              | 1 carton                   | Same specifications as above for No. 1 and No. 2 grades but machine-trimmed for exactly parallel edges with butts sawn at precise right angles. For sidewall application where tightly fitting joints are desired. |
| or    | 18" (Perfections) | .45"                   | 28                              | 1 carton                   |                                                                                                                                                                                                                    |
| No. 2 | 24" (Royals)      | .50"                   | 13                              | 4 bdls                     |                                                                                                                                                                                                                    |

**NOTE:** Wood shingles have a potential of higher fire danger than asphalt or fiberglass shingles. Some manufacturers treat wood shingles with special fire retardant chemicals. Be sure to compare the manufacturer's specifications to the requirements of local fire codes.

- Tile shingles

**FIGURE 16**

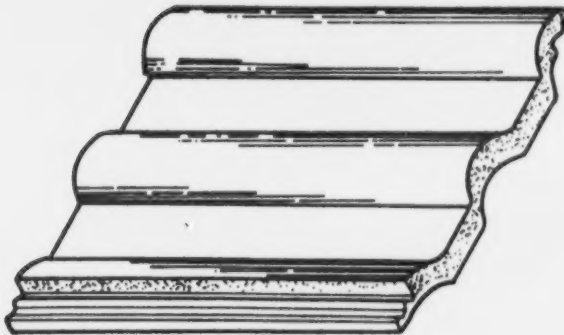


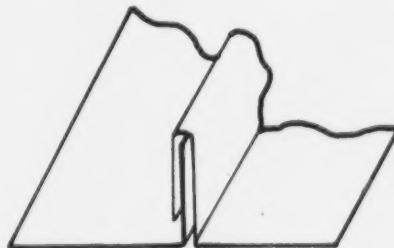
**FIGURE 17**



**NOTE:** The shingles can be made of clay, concrete, or plastic. There are several accessory tile shapes available.

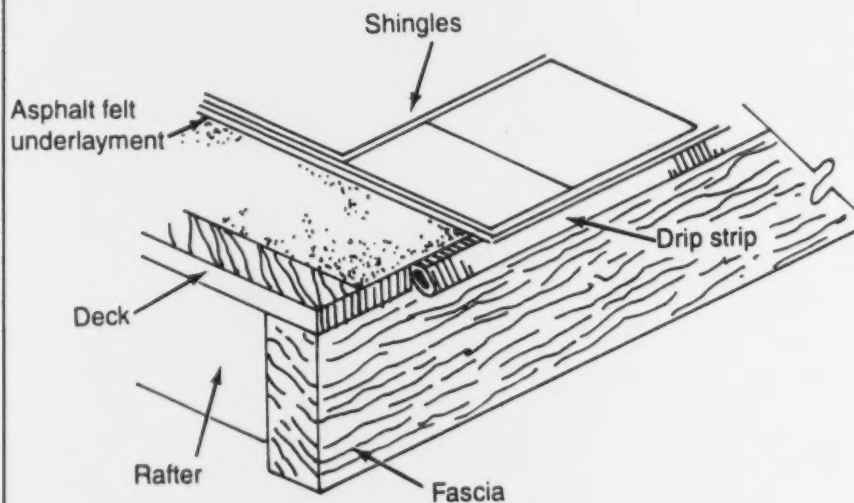
- Standing seam (metal building)

**FIGURE 18**



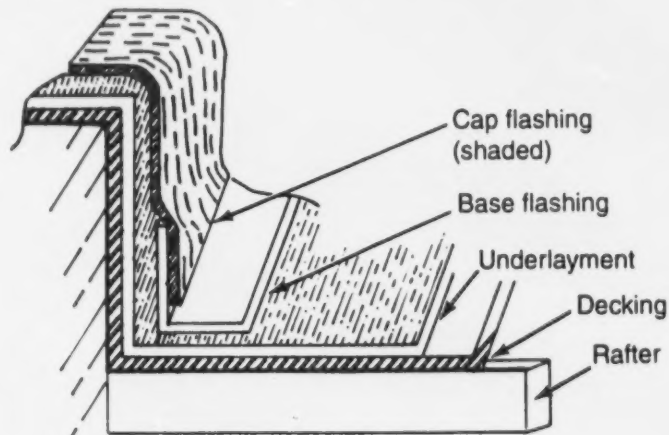
- Underlayment — The most common roofing underlayments are asphalt and saturated felt. Underlayment provides an additional barrier against moisture, wind, and wind-driven snow (Figure 19).
- Drip strips — Drip strips protect roof edges, fascia, and exterior walls from moisture (Figure 19).

**FIGURE 19**



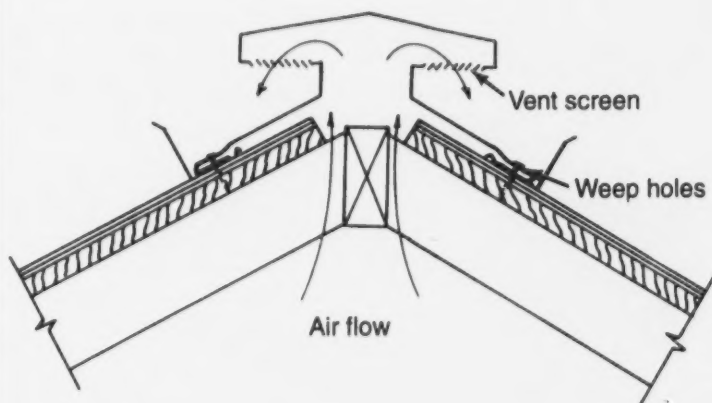
- Caps — Caps are sheets of metal flashing used on vertical roofing surfaces. Caps extend downward and bend over base flashing to prevent moisture penetration (Figure 20).

**FIGURE 20**



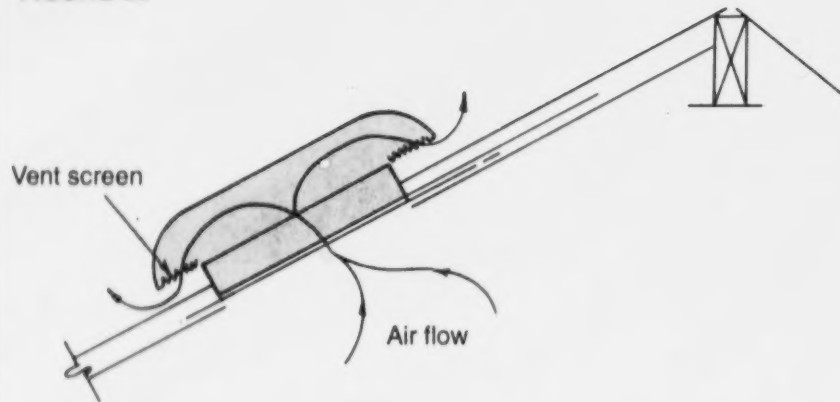
- Vents and louvers
  - Ridge vents

**FIGURE 21**



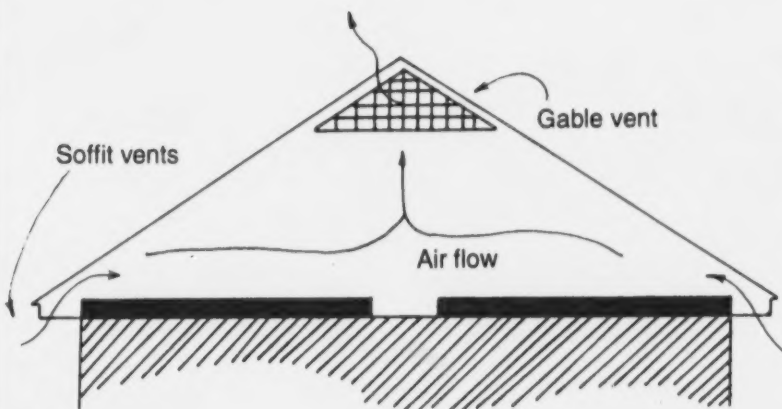
— Roof vent

FIGURE 22



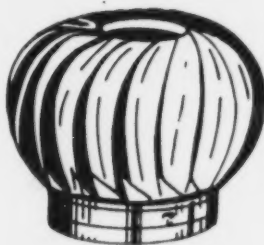
— Gable and soffit vents

FIGURE 23



— Turbine ventilator

**FIGURE 24**



**NOTE:** Vents or ventilators can be powered by electric motors, wind driven, or be passive (allow air passage without being driven).

- Louvers — Louvers are vented coverings, usually made of metal, that allow air flow but prevent rain and pests from entering the attic.

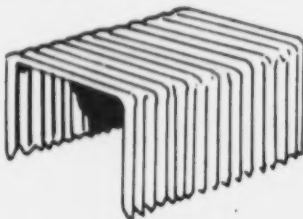
**NOTE:** Vents and louvers are often combined to form an attic ventilation system for a structure.

**OBJECTIVE 5**

**Provided drawings, match roofing fasteners to their names.**

- Roofing staples

**FIGURE 25**



**NOTE:** Staples are available in several lengths from  $\frac{1}{2}$ " to  $1\frac{1}{4}$ ". Consult with local codes and/or your supervisor. Staple use may not be recommended in all locations.

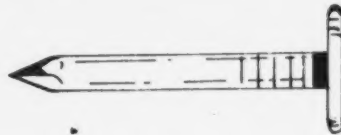
- Box nail

**FIGURE 26**



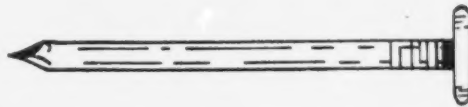
- Galvanized roofing nail

**FIGURE 27**



- Simplex nail

**FIGURE 28**



- Ply-clip

**FIGURE 29**

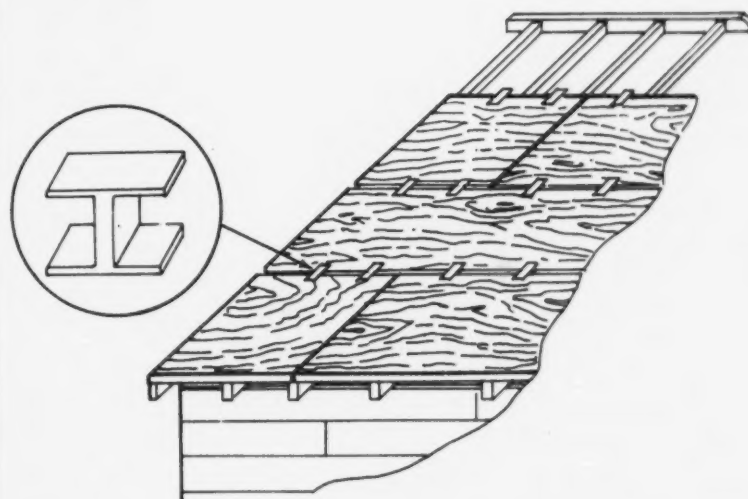




**TABLE 3: ROOFING FASTENERS**

| Roofing Material                  | Type of Nail or Fastener                                                                                                               | Size                                  | Comments                                                                               |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|----------------------------------------------------------------------------------------|
| Wood shingles and shakes          | Nails or staples                                                                                                                       | 3d, 4d, 5d, 6d, or equal-size staples |                                                                                        |
| Asphalt shingles and roll roofing | Plain, barbed nails<br>Angular-thread nails<br>Spiral-thread nails<br>Galvanized roofing nails<br>Nails with tin washers<br>Felt nails | 1" to 1¾"                             |                                                                                        |
| Tile roofing                      | Rust-resistant nails<br>Snow guards<br>Hurricane clips<br>Metal repair straps<br>Eave-closure strip                                    | 1¼" to 1¾"                            | Hurricane clips should be used where winds over 70 miles per hour are likely to occur. |

**NOTE:** Fasteners should be made of rust-resistant metals.

**OBJECTIVE 6**

**Identify materials used on commercial buildings that utilize built-up roofing methods.**

- Introduction

There are three types of roof decks that commonly used the built-up roofing method.

- Metal roofing decks
- Concrete roofing decks
- Wooden roofing decks

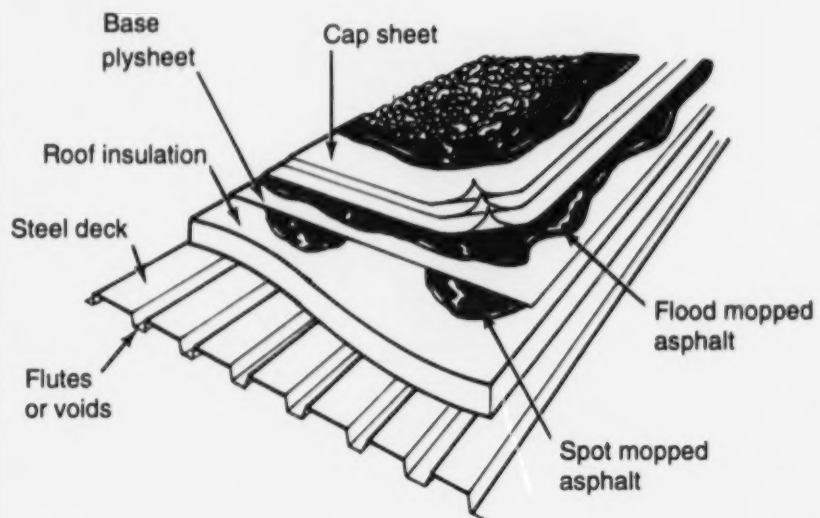


- Metal roofing deck

Materials for a built-up roofing system (Figure 30) for metal roofing decks consists of:

- Roof insulation with fasteners
- Base plysheet
- One or more intermediate plysheets
- Cap sheet
- Hot asphalt (or torch down)
- Flashing (not shown)

**FIGURE 30**



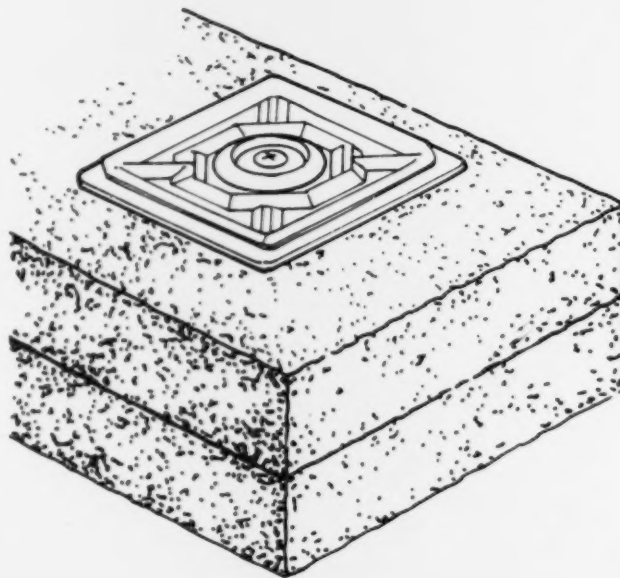
- Roof insulation

- Roof insulation is available in several thicknesses and R-values.

**NOTE:** Roof insulation has a "flute spanability" rating. These ratings must be carefully noted—too much weight on the insulation could cause the insulation to be depressed into the metal decking flutes or voids.

- The most common roof insulation is in sheets factory cut to 4' x 8' or 4' x 4' dimensions.
- Roof insulation sheets are fastened to the steel decks with special fasteners and grip plates (Figure 31).

**FIGURE 31**



- The fastener spacing depends on the manufacture of the insulated sheets and building codes. A typical spacing is shown below (Figures 32 and 33).

**FIGURE 32**

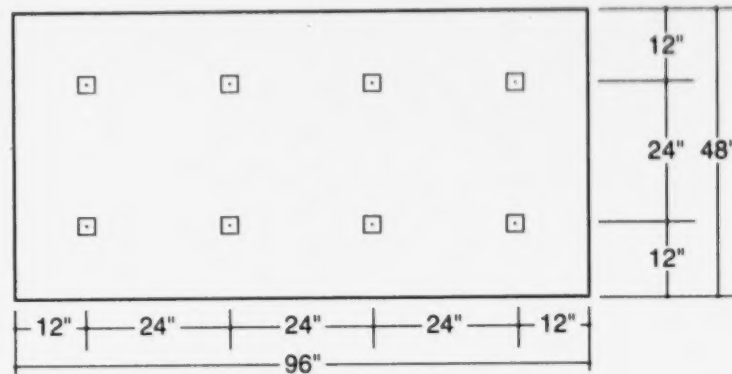
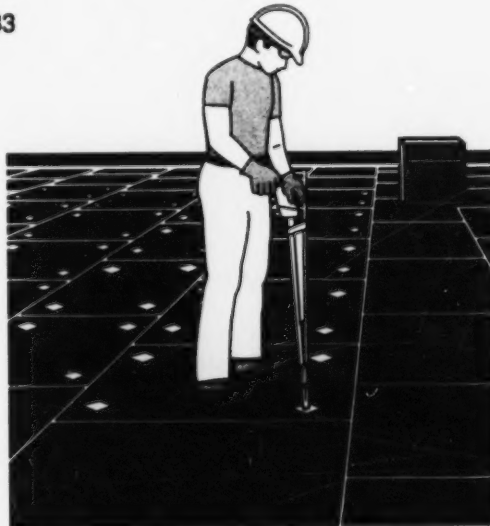


**FIGURE 33**



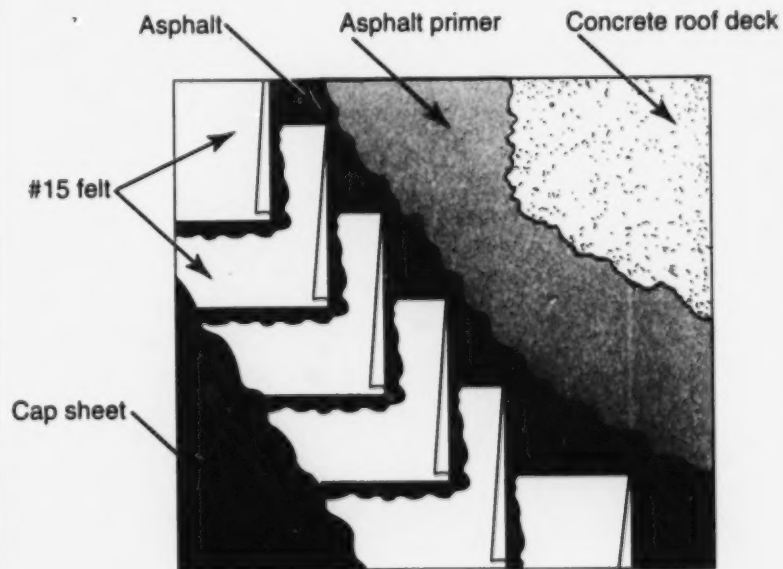
**NOTE:** Some manufacturers and building codes allow the use of roofing tape to hold roof insulation in place.

- Concrete roof decks

Material used for built-up roofs on concrete roof decks (Figure 34) consists of:

- Asphalt primer
- Hot asphalt
- Base plysheet
- Intermediate plysheets
- Cap sheets or glaze coat
- Insulation (optional)
- Flashing (not shown)

**FIGURE 34**

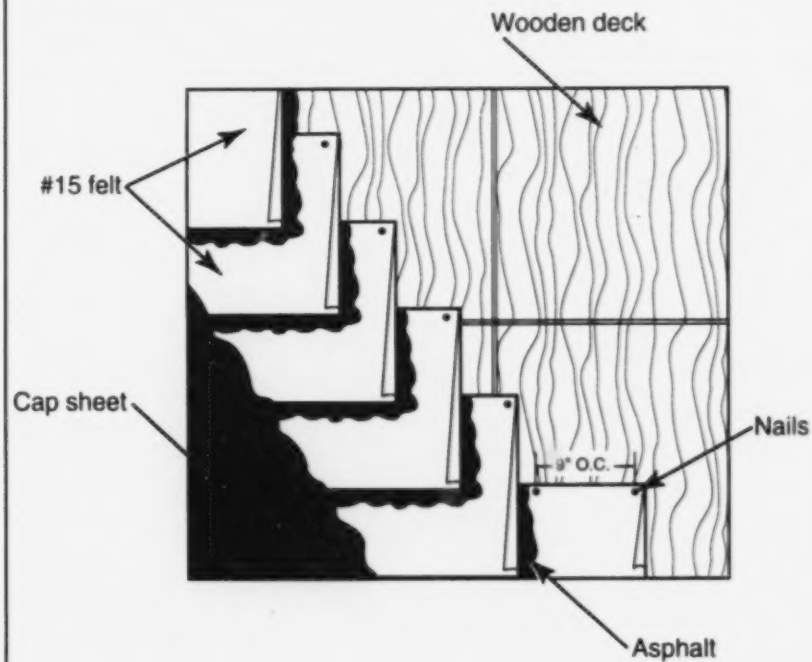


- Wooden roof decks

The material used in built-up roofing systems for wooden roofing decks (Figure 35) consist of:

- Base plysheet
- Intermediate plysheets
- Cap sheets
- Hot asphalt
- Nails
- Insulation (optional)
- Flashing (not shown)

**FIGURE 35**



- Material to apply felt plysheets

These can be installed with a mop (using hot asphalt) or be torch heated to build up the roof surface.

- Mopped plysheet application

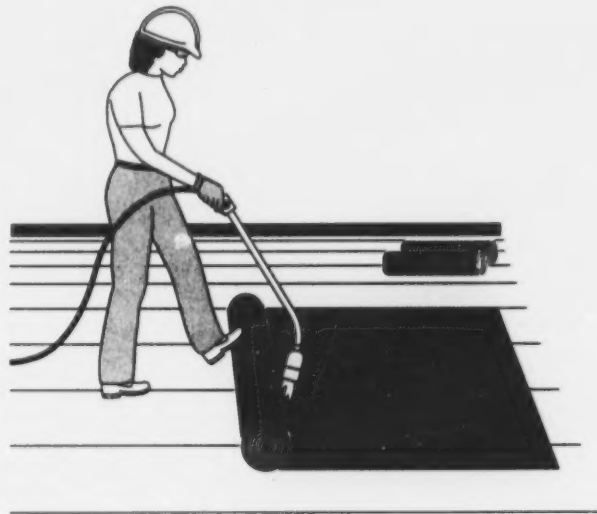
**FIGURE 36**





— Torch heated application

**FIGURE 37**



**NOTE;** Using the torch heated method requires special precautions to prevent fires. Consult the torch manufacturer and your supervisor before using a roofing torch.

**OBJECTIVE 7**

**Name the purpose and material types used for flashing.**

- **Purpose**

Flashing prevents water or moisture from entering a structure. Flashing must be used wherever there is a change in roof slope, where there is a roof opening, or where there is a projection from the roof surface.

Flashing must be formed snugly against plumbing vents. Pre-formed flashing can be purchased for many standard sizes of plumbing vents that extend above the roof.

- **Material types**

Flashing can be made of aluminum, copper, galvanized sheet metal, roll roofing, sheet lead, neoprene, or prefinished metal.

**OBJECTIVE 8**

**Estimate roofing materials needed for a three-tab asphalt-shingle roof.**

**NOTE:** One square of strip shingles—enough to cover 100 square feet of roof—requires approximately seventy-six shingles. The actual number of shingles per square will vary slightly from manufacturer to manufacturer. The squares are sold by bundles, with three bundles per square.

1. Calculate number of squares needed to cover roof surfaces.
  - a. Measure length and width of each roof surface.

**NOTE:** Measure valleys and hips at the halfway point. Where roof surfaces are symmetrical, measure one side and double measurement.



FIGURE 38

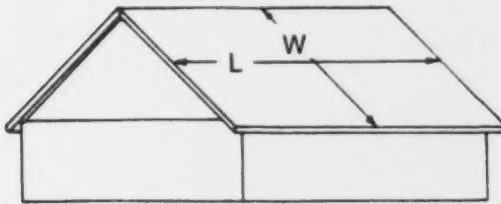
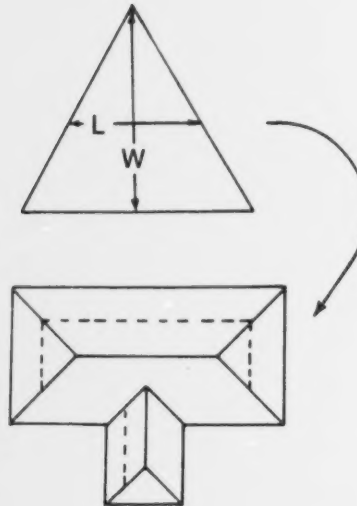


FIGURE 39



- b. Use the formula of

$$L \times W = \text{area of roof surface}$$

L = length

W = width

- c. Multiply length times width of each surface to find square footage of each roof surface.

**EXAMPLE:** If there are two 15' x 30' roof surfaces and two 12' x 24' roof surfaces, then

$$15' \times 30' = 450 \text{ sq ft}$$

$$15' \times 30' = 450 \text{ sq ft}$$

$$12' \times 24' = 288 \text{ sq ft}$$

$$12' \times 24' = 288 \text{ sq ft}$$

- d. Add total square footage.

**EXAMPLE:** If there are two 450-square-foot roof surfaces and two 288-square-foot surfaces, then

$$\begin{array}{r} 450 \text{ sq. ft.} \\ 450 \text{ sq. ft.} \\ 288 \text{ sq. ft.} \\ \hline 288 \text{ sq. ft.} \\ 1,476 \text{ sq. ft.} = \text{Total square footage} \end{array}$$

- e. Measure length and width of each roof opening.
- f. Multiply length times width of each opening to find square footage of each opening.
- g. Subtract square footage of any opening larger than 30 square feet from total square footage of roof surface.
- h. Divide remaining total square footage by 100 to find number of squares of shingles needed to cover roof surfaces.

**NOTE:** One hundred is the number of square feet of coverage per square of shingles.

**EXAMPLE:** If there are 1,476 square feet of roof, then

$$1,476 \div 100 = 14.76 \text{ squares needed to cover roof surfaces}$$

2. Calculate number of squares needed to cover ridge.

**NOTE:** Some shingle manufacturers provide pre-packaged hip and ridge roofing.

- a. Measure each ridge.
- b. Add all ridge measurements to find total lineal feet of ridge.



- c. Divide total lineal feet of ridge by 25 to find number of bundles of shingles needed to cover ridge.

**NOTE:** One bundle (one-third square) will cover approximately 25 lineal feet or ridge.

**EXAMPLE:** If there are 108 lineal feet or ridge with 5-inch exposure, then

$$108 \div 25 = 4.32 \text{ bundles}$$

- d. Divide number of bundles by 3 to find number of squares needed to cover ridge.

**NOTE:** There are three bundles in a square.

**EXAMPLE:** If there are 4.32 bundles, then

$$4.32 \text{ bundles} \div 3 = 1.44 \text{ squares needed to cover ridge}$$

3. Calculate number of squares needed to cover starter row.

- a. Measure number of lineal feet of eave.  
b. Multiply lineal feet of eave by 2 to allow for double row.

**EXAMPLE:** If there are 108 lineal feet of eave, then

$$108 \times 2 = 216 \text{ lineal feet of eave in starter row}$$

- c. Divide lineal feet of eave by 3 to find number of shingles.

**NOTE:** A standard strip shingle is approximately 3 feet long.

**EXAMPLE:** If there are 216 lineal feet of eave, then

$$216 \div 3 = 72 \text{ shingles}$$



- d. Divide number of shingles by 76 to find number of squares.

**EXAMPLE:** If there are 72 shingles needed for eave, then

$$72 \div 76 = 0.95 \text{ squares needed to cover starter row}$$

4. Calculate square of waste — Multiply number of squares needed to cover surfaces times percentage of waste.

**NOTE:** Shape and design of roof determine amount of waste. The more valleys, chimneys, dormers, split levels, and so on, the higher the percentage of waste. Waste percentages usually range from 2 percent to 5 percent for material estimates.

5. Calculate total squares needed to cover roof — Add amounts determined in steps 1 through 4 and round up to next whole number if necessary.



**EXAMPLE:** If 14.76 squares are needed to cover the roof surfaces, 1.44 squares are needed to cover the ridge, 0.95 square is needed to cover double starter row, and there are .44 (3%) squares of waste, the

Roof surfaces = 14.76 squares

Ridge = 1.44 squares

Double starter row = 0.95 squares

Waste = .44 squares

---

17.59 squares  
needed to cover  
roof

Order 18 squares.

6. Calculate rolls of felt for underlayment — Divide number of squares of singles needed to cover roof surfaces by 4 and round up to next whole number if necessary.

**NOTE:** Common felt used for underlayment is #15 asphalt-impregnated. The common size is 36 inches wide x 144 lineal feet long, or 4 squares per roll.

**EXAMPLE:** If there are 14.76 squares needed to cover roof surfaces, then

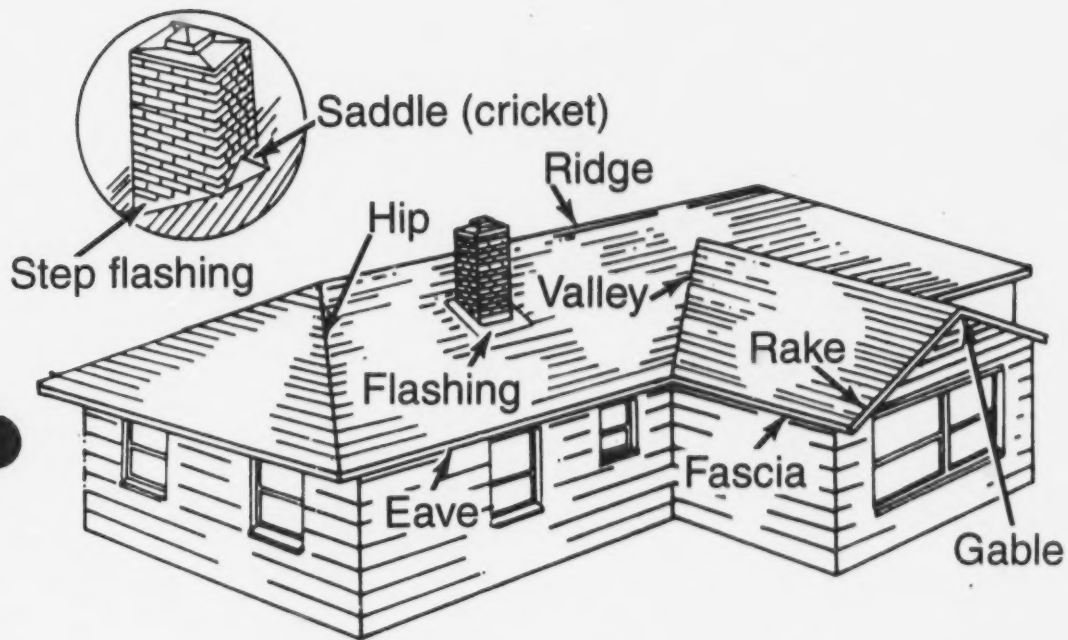
$14.76 \div 4 = 3.69$  rolls of felt for underlayment

7. Check plans to determine amount of materials that will be needed for valleys, roof edging, and flashing as required by architectural design.



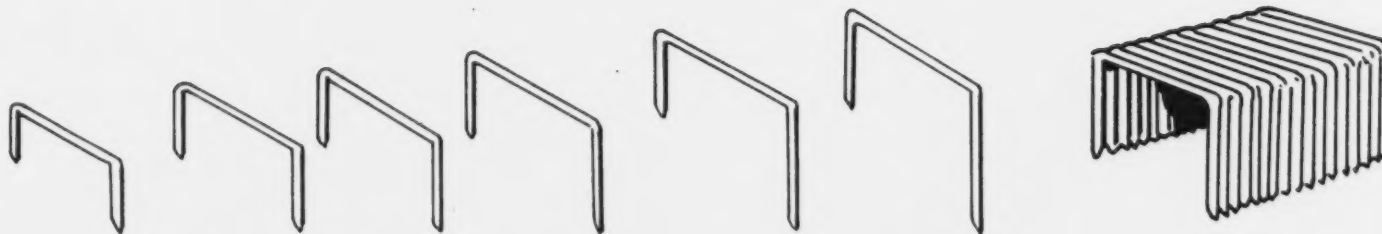


# Parts of a Roof



# Roofing Fasteners

## Staples

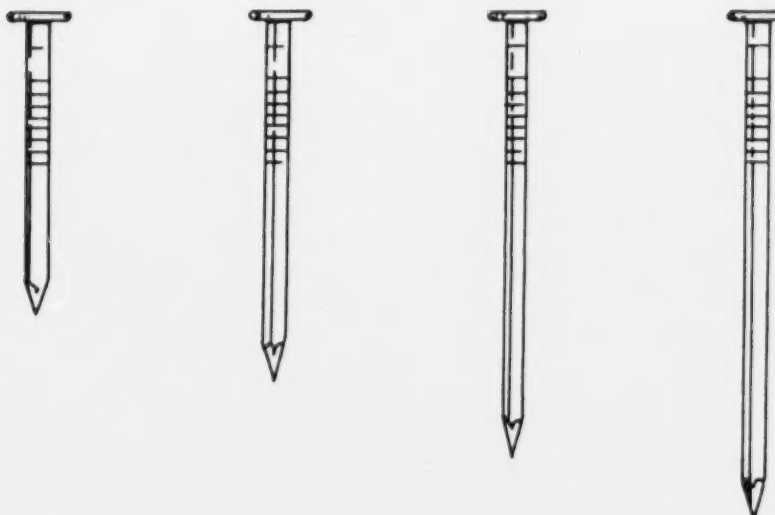


Wide-crown roofing staples have a 1-inch crown and come in length from  $\frac{1}{2}$  inch to  $1\frac{1}{4}$  inches.

# Roofing Fasteners

## (Continued)

### Galvanized Box Nails



Galvanized box nails (shingle nails) are used to fasten cedar and shake shingles. They come in sizes from 3d to 6d, as specified by the penny system.

TM 3

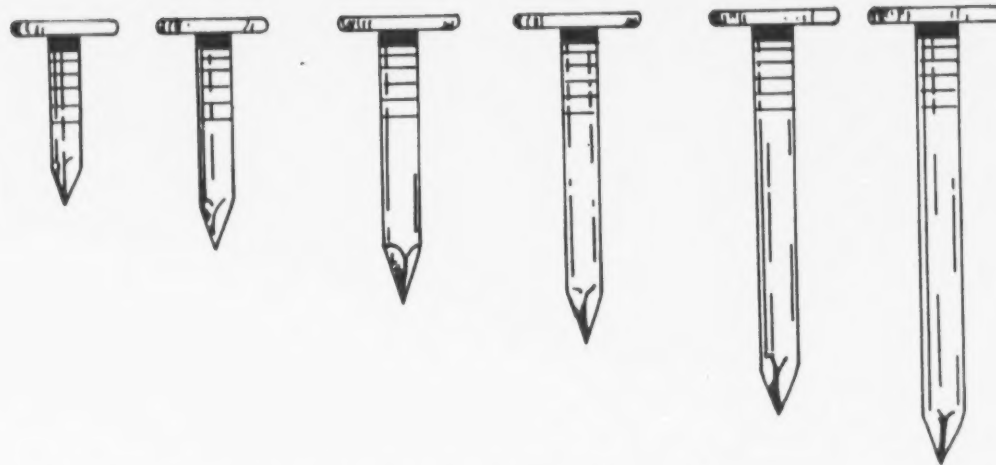
67



# Roofing Fasteners

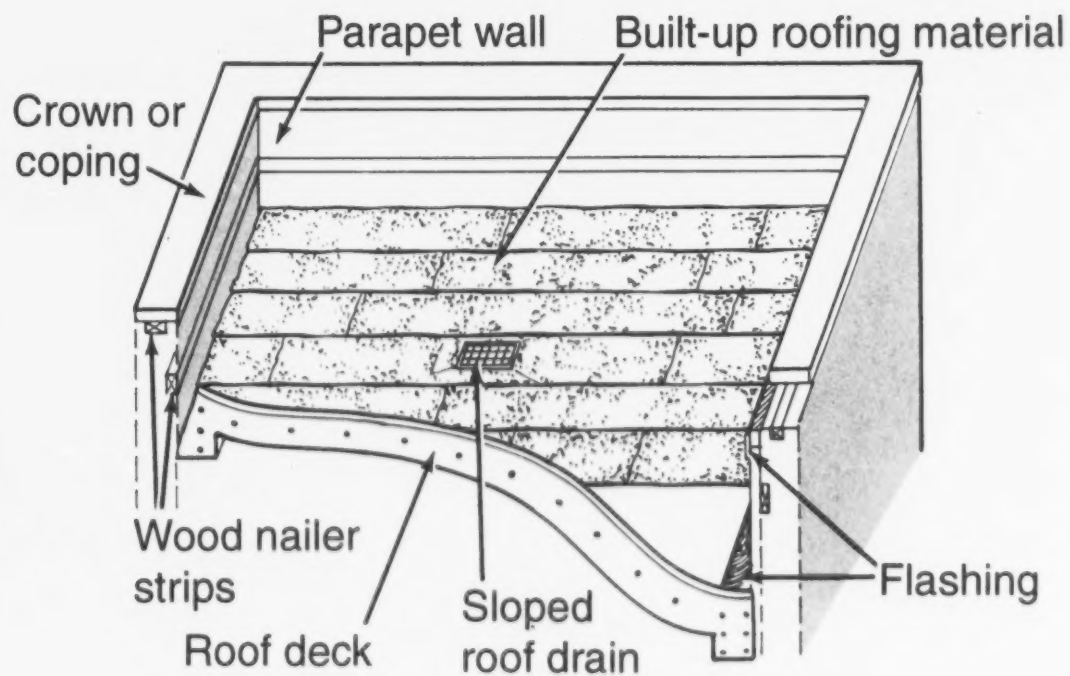
## (Continued)

### Galvanized Roofing Nails



Galvanized roofing nails are not specified by the penny system; their lengths are measured in inches. Typical sizes are  $\frac{3}{4}$  inch to 2 inches. They have large heads.

# Built-up Roofing Materials



**ASSIGNMENT  
SHEET**

**ROOFING MATERIALS**

**A 1**

Name \_\_\_\_\_ Score \_\_\_\_\_

**OBJECTIVE 7**

**Estimate the material required to install a three-tab asphalt-shingle roof.**

**INTRODUCTION**

During this exercise, you will estimate the materials required to cover a roof of a 20' x 46' structure. Once the decking is on a roof, it is important to get the roofing on as quickly as possible to protect the decking and the framing members. For this reason, most builders like to have all roofing materials available at one time so that the job can be finished without delay. One delay that must be avoided is not having enough material to complete the job. Consequently, estimates for roofing materials must be accurate.

**DIRECTIONS**



Operation and  
Calculation Skills

- Calculate with whole numbers
- Calculate with fractions
- Calculate with decimals
- Solve formulae and equations

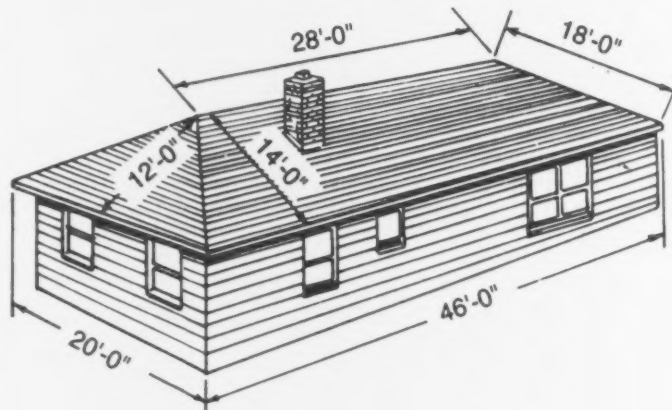
Math Application Skills

- Use English and metric measures
- Apply geometry principles

Data Analysis  
and Display

- Interpret charts and tables

Study the illustration of the house below and estimate the materials that will be needed to cover the roof with three-tab asphalt shingles applied with 5-inch exposure. Write the correct answers in the blanks below. Round your answers up to the nearest tenth. Show your work.



71





Job Acquisition/  
Development Skills  
• Master specific job  
task/procedure

1. Squares needed to cover roof surface = \_\_\_\_\_
2. Squares needed to cover ridge = \_\_\_\_\_
3. Squares needed to cover double starter row = \_\_\_\_\_
4. Squares of waste (calculate at 3%) = \_\_\_\_\_
5. Total squares that need to be ordered = \_\_\_\_\_
6. Rolls of underlayment that need to be ordered = \_\_\_\_\_





**ASSIGNMENT  
ANSWERS**

**ROOFING MATERIALS**

**A 1**

**ASSIGNMENT  
SHEET**

1. 12.8 squares
2. 1.4 squares
3. 1.2 squares
4. .4 squares (approximately 3% waste)
5. 16 squares
6. 4 rolls



**WRITTEN  
TEST**

**ROOFING MATERIALS**

**A 1**

Name \_\_\_\_\_ Score \_\_\_\_\_

**OBJECTIVE 1**

**Given a list of terms associated with roofing materials, match them to their correct definitions. Write the letter that corresponds to the most correct answer.**

- \_\_\_\_\_ 1. The amount of roofing needed to provide 100 square feet of finished roofing is a
- a. meter
  - b. square
  - c. block
  - d. square module
- \_\_\_\_\_ 2. The bottom edge of a shingle is the
- a. exposure edge
  - b. flashing
  - c. drip edge
  - d. butt edge
- \_\_\_\_\_ 3. The material used to form a roof such as plywood or sheet metal is the
- a. decking
  - b. exposure
  - c. platform
  - d. exterior layer
- \_\_\_\_\_ 4. The portion of a shingle that is subjected to weathering is known as
- a. exposure
  - b. flash
  - c. overlap
  - d. drip edge



- \_\_\_\_\_ 5. The slot or opening in a tab shingle is the
- a. slotted channel
  - b. cutout
  - c. water channel
  - d. both b and c are correct
- \_\_\_\_\_ 6. The 1 x boards that are nailed to rafters with spacings equal to the width of the boards are
- a. slats
  - b. spaced deck sheathing
  - c. bracing boards
  - d. plywood decking
- \_\_\_\_\_ 7. A wood product made up of several layers of veneer that are glued together is
- a. squares
  - b. plywood
  - c. decking
  - d. ply-clip sheet
- \_\_\_\_\_ 8. Metal fasteners that are used to secure plywood edges are
- a. T & G clips
  - b. ply-clamps
  - c. ply-clips
  - d. both a and b are correct
- \_\_\_\_\_ 9. The incline of the roof as a ratio of vertical rise to horizontal run is
- a. incline
  - b. grade
  - c. rise
  - d. slope

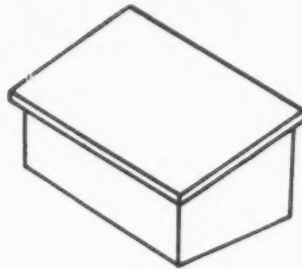


- \_\_\_\_\_ 10. Protected openings in a roof that reduces attic heat and moisture levels are
- a. turbine vents
  - b. ridge vents
  - c. soffit vents
  - d. all the above
- \_\_\_\_\_ 11. Sheetmetal used to prevent rain or other moisture from entering a structure is known as
- a. slope shield
  - b. ply-clip
  - c. soffit cover
  - d. flashing

**OBJECTIVE 2**

**Given drawings, identify common roof designs.**

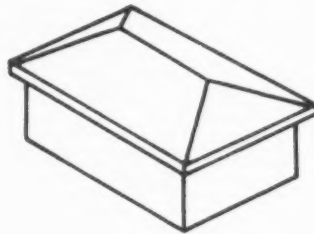
- \_\_\_\_\_ 1. The figure shown below represents a \_\_\_\_\_ roof.



- a. lean
- b. sloped-angle
- c. shed
- d. monopitched

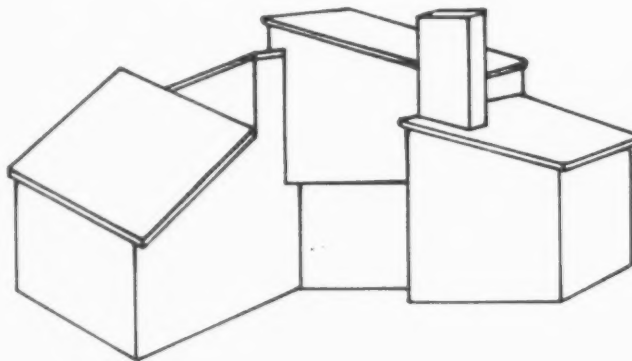


\_\_\_\_\_ 2. This figure represents a \_\_\_\_\_ roof.



- a. shed
- b. gable
- c. mansard
- d. hip

\_\_\_\_\_ 3. The roof represented in the figure below is a

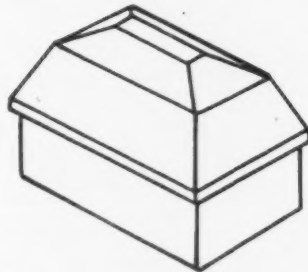


- a. monopitched
- b. flat
- c. hip
- d. shed-in-hip

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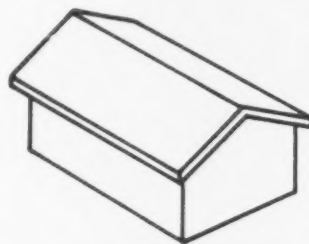


\_\_\_\_\_ 4. The roof pictured below represents a



- a. flat
- b. barn sloped
- c. gambrel
- d. mansard

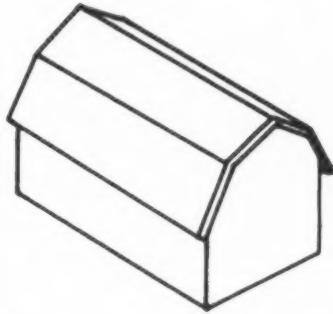
\_\_\_\_\_ 5. The drawing below shows a \_\_\_\_\_ roof.



- a. mansard
- b. gable
- c. hip
- d. monopitched



\_\_\_\_\_ 6. The roof represented in the figure below is a



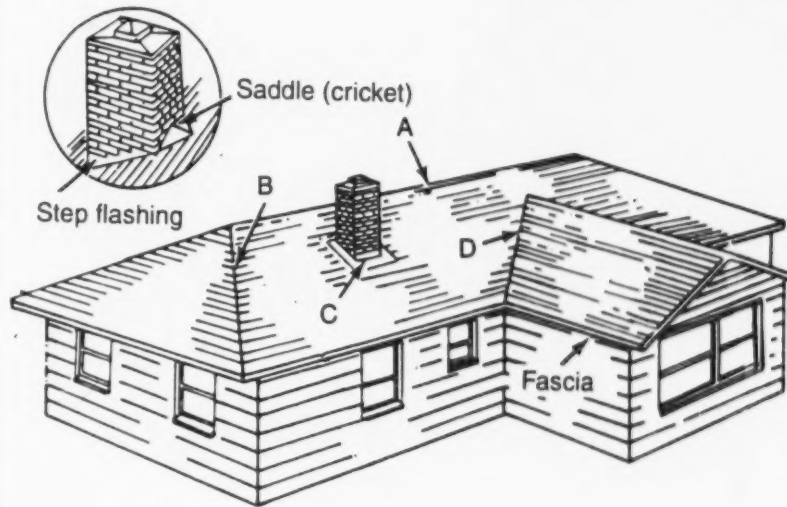
- a. gambrel
- b. double-sloped
- c. gable
- d. half-hip





**OBJECTIVE 3**

**Identify the parts of a roof.** Use the figure below to identify the parts of a roof.



- \_\_\_\_\_ 1. The roof part identified by the letter "A" in the figure above is
- a. hip
  - b. apex
  - c. ridge
  - d. eave
- \_\_\_\_\_ 2. The roof part "B" identified above is a
- a. hip
  - b. ridge
  - c. valley
  - d. seam



\_\_\_\_\_ 3. The roof part identified by "C" in the figure above is the

- a. ridge
- b. rake
- c. fascia
- d. flashing

\_\_\_\_\_ 4. The roof part identified by "D" in the figure above is the

- a. channel
- b. rake
- c. hip
- d. valley

**OBJECTIVE 4**

**Given drawings, identify basic types of shingles, underlayment, drip strips, caps, louvers and vents.**

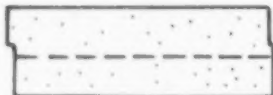
\_\_\_\_\_ 1. The shingle type shown below represents a



- a. strip shingle
- b. wood-appearance with tabs
- c. strip shingle with tabs
- d. individual lockdown

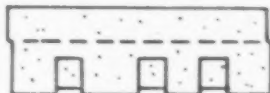


\_\_\_\_ 2. The shingle represented in the drawing below is



- a. strip shingle without tabs or a starter shingle
- b. wood-appearance (single thickness)
- c. wood-appearance (double thickness)
- d. individual lockdown

\_\_\_\_ 3. The drawing below represents a



- a. strip shingle with tabs
- b. wood-appearance (double thickness)
- c. wood-appearance (single thickness)
- d. strip shingle without tabs

\_\_\_\_ 4. The shingle shown below is a

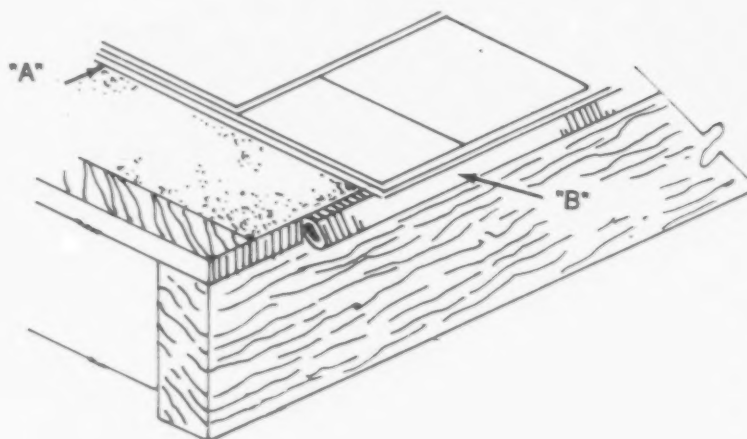


- a. plastic based shingle
- b. flat overlap shingle
- c. wood shingle
- d. tab shingle



**DIRECTIONS**

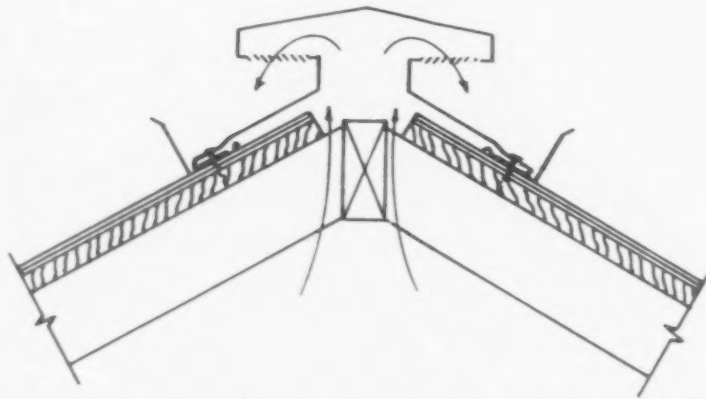
Use the figure below to answer questions 5-6.



- \_\_\_\_\_ 5. The roof element identified by the "A" in the above drawing is
- a. drip layer
  - b. asphalt felt underlayment
  - c. shingle
  - d. drip strip
- \_\_\_\_\_ 6. The element represented in the drawing above labeled with the "B" is the
- a. drip strip
  - b. fascia
  - c. deck
  - d. rafter

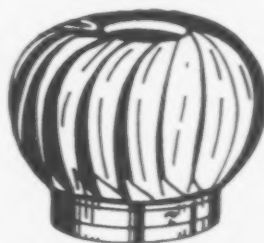


\_\_\_\_ 7. The type of vent represented in the drawing below is a



- a. crown vent
- b. roof vent
- c. soffit vent
- d. ridge vent

\_\_\_\_ 8. The vent illustrated below is a



- a. ridge vent
- b. gable vent
- c. turbine vent
- d. roof vent

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OBJECTIVE 5

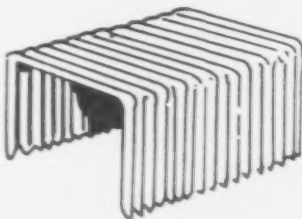
Provided drawings, match roofing fasteners to their names.

\_\_\_\_\_ 1. The figure below is a/an



- a. "I" clip
- b. tee-bars
- c. ply-clip
- d. inserts

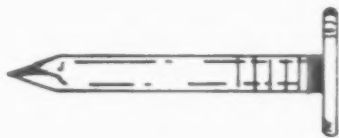
\_\_\_\_\_ 2. The figure below represents



- a. "U" clips
- b. staples
- c. spacers
- d. ply-clip



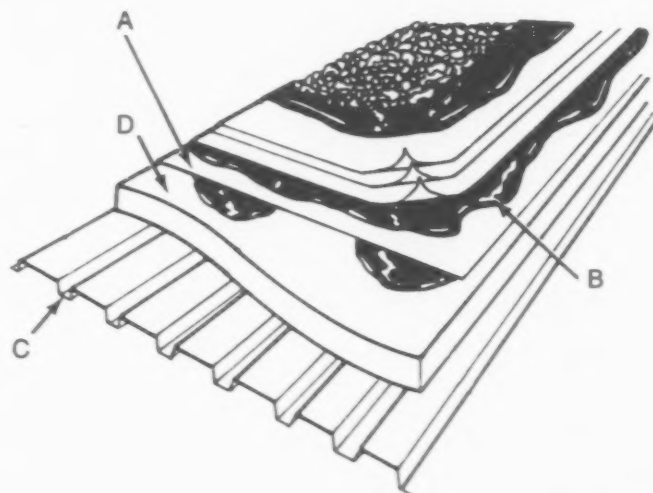
\_\_\_\_\_ 3. The fastener pictured below is a



- a. roofing nail
- b. box nail
- c. ridge nail
- d. concrete nail

**OBJECTIVE 6**

**Identify materials used on commercial buildings that utilize built-up roofing methods.** Use the figure below to answer questions 1 through 4.





- \_\_\_\_\_ 1. The material identified by the "A" in the above drawing is the
- a. mopped asphalt
  - b. roof insulation
  - c. cap sheet
  - d. base plysheet
- \_\_\_\_\_ 2. The material marked by the "B" in the figure is
- a. steel deck
  - b. mopped asphalt
  - c. base ply
  - d. water seepage
- \_\_\_\_\_ 3. Item "C" of the figure is
- a. flutes or voids
  - b. mopped asphalt
  - c. roof drain slots
  - d. cap lumber
- \_\_\_\_\_ 4. Item "D" can be identified as the
- a. base ply
  - b. base plywood
  - c. roof insulation
  - d. fiberboard decking

**OBJECTIVE 7**

**Name the purpose and material types used for flashing.**

- \_\_\_\_\_ 1. The purpose of flashing is to
- a. reflect sunlight
  - b. reinforce fasteners
  - c. prevent insects from entering a roof
  - d. prevent water or moisture from entering a structure



\_\_\_\_\_ 2. Types of material used for flashing material include

- a. galvanized metal
- b. copper
- c. aluminum
- d. all the above

---

**NOTE:** Objective 8 is evaluated on an assignment sheet in this unit. If you have not completed this component, see your instructor.



**WRITTEN TEST  
ANSWERS****ROOFING MATERIAL****A 1****OBJECTIVE 1**

- |      |       |
|------|-------|
| 1. b | 7. b  |
| 2. d | 8. c  |
| 3. a | 9. d  |
| 4. a | 10. d |
| 5. c | 11. d |
| 6. b |       |

**OBJECTIVE 2**

- |      |      |
|------|------|
| 1. c | 4. d |
| 2. d | 5. b |
| 3. a | 6. a |

**OBJECTIVE 3**

- |      |      |
|------|------|
| 1. c | 3. d |
| 2. a | 4. d |

**OBJECTIVE 4**

- |      |      |
|------|------|
| 1. a | 5. b |
| 2. c | 6. a |
| 3. a | 7. d |
| 4. b | 8. c |



**OBJECTIVE 5**

1. c
2. b
3. a

**OBJECTIVE 6**

- |      |      |
|------|------|
| 1. d | 3. a |
| 2. b | 4. c |

**OBJECTIVE 7**

1. d
2. d

**OBJECTIVE 8**

Evaluated through the completion of an assignment sheet.



TOTAL NUMBER OF BASIC SKILL QUESTIONS 0



| OBJECTIVE<br>SHEET     | ROOFING TOOLS<br>AND EQUIPMENT <span style="float: right;">A 2</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| INTRODUCTION           | <p>This unit provides an overview of the most common tools and equipment used in residential and light commercial roofing.</p> <p>Using roofing tools and equipment safely requires you to closely observe the guidelines as stated by OSHA and those described in this unit.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| PREREQUISITE           | <i>Fundamentals of Construction</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| UNIT<br>OBJECTIVE      | <p>After completing this unit, the student will be able to identify and use selected roofing tools and equipment. The student will demonstrate these competencies by completing the assignment sheet, job sheets, and written test with a minimum of 85 percent accuracy.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| SPECIFIC<br>OBJECTIVES | <p>After completing this unit, the student will be able to show the ability to:</p> <ol style="list-style-type: none"> <li>1. Given a list of terms associated with roofing tools, match them to their correct definitions.</li> <li>2. From alternatives, choose the proper care and safety guidelines for the use of hand and power tools.</li> <li>3. Given drawings, identify safety equipment and hand tools used for the installation of roofs. (Assignment Sheet 1)</li> <li>4. Given drawings, identify power tools and equipment used for the installation of roofs. (Assignment Sheet 2)</li> <li>5. Use a roofer's hatchet properly. (Job Sheet 1)</li> <li>6. Use a pneumatic fastener. (Job Sheet 2)</li> </ol> |



| SUGGESTED<br>ACTIVITIES | ROOFING TOOLS<br>AND EQUIPMENT <span style="float: right;">A 2</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PREPARATION             | <ul style="list-style-type: none"> <li>• Review unit and plan presentation.</li> <li>• Order or obtain materials to supplement unit.</li> <li>• Introduce unit.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| DELIVERY                | <p><b>Objective 1: Given a list of terms associated with roofing tools, match them to their correct definitions.</b></p> <ul style="list-style-type: none"> <li>• Use the Information Sheet to discuss definitions.</li> </ul> <p><b>Objective 2: From alternatives, choose the proper care and safety guidelines for the use of hand and power tools.</b></p> <ul style="list-style-type: none"> <li>• Use the Information Sheet to describe guidelines for the safe use of roofing tools and equipment.</li> <li>• Demonstrate the safe use of all equipment, including conveyors, hoists, and tools.</li> <li>• Demonstrate the proper use of ladders, emphasizing the particular safety rules that pertain to ladders in your training facility; point out safety labeling on ladders and address special dangers of using metal ladders around electrical wiring and power lines.</li> <li>• Invite a roofer to discuss safety issues with your class. Emphasize the use of lifelines and toeboards.</li> <li>• Show the AGC videos on safety.</li> </ul> |
| APPLICATION             | <p><b>Objective 3: Given drawings, identify safety equipment and hand tools used for the installation of roofs. (Assignment Sheet 1)</b></p> <p><b>Objective 4: Given drawings, identify power tools and equipment used for the installation of roofs. (Assignment Sheet 2)</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |





## EVALUATION

**Objective 5: Use a roofer's hatchet properly. (Job Sheet 1)**

**Objective 6: Use a pneumatic fastener. (Job Sheet 2)**

- Allow students to practice the procedures in the assignment and job sheets.

### Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

### Skill Test

- Evaluate students on assignment sheet activities.
- Evaluate students on job sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

### Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give the written test.

**NOTE:** The written test may be given in sections if desired.

- Complete appropriate sections of competency profiles.

**SUGGESTED  
RESOURCES**

**UNIT  
REFERENCES**

- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

***Electronic Media***

The following VHS safety videos are available from AGC of America, 1957 E Street N.W., Washington, D.C. 20006.

- *Ladder Safety*
- *Working Safely on Scaffolds*
- *Modern Carpentry.* Goodheart-Willcox, 123 West Taft Drive, South Holland, IL 60473-2089. Phone 708-333-7200 or 800-323-0440.
- *Roofing Three: Steep Roofing.* Joint Apprenticeship Committee of the United Union of Roofers, Waterproofers and Allied Workers, and the National Roofing Contractors Association.
- Toenjes, Leonard P. *Building Trades Dictionary.* American Technical Publishers, Inc.: Homewood, IL 60430.

OBJECTIVE 1

Given a list of terms associated with roofing tools, match them to their correct definitions.

- **chalk box/line** — a small box filled with a string line and colored chalk to mark a straight line
- **combination tin snips** — tool used to cut flashing materials
- **extension ladder** — equipment used to provide access to or exit from roof; also used in pairs to support ladder jacks and scaffold planks
- **ground fault circuit interruption (GFCI)** — special circuits used to protect workers from electrical shock when using AC powered tools and equipment
- **hatchet (shingler's or roofing)** — tool used to drive and space nails or to cut shingles
- **hoisting equipment** — equipment used to move material from ground or truck to roof, or from one location to another

EXAMPLES: Hand hoist, hand beam-hoist, swing beam-hoist, ladder-platform hoist, conveyor

- **keel (marking crayon)** — tool used to mark lines and dimensions, to make marks indicating leaks or other defects, and to write special instructions
- **ladder jacks and scaffold plank** — equipment used in pairs to form a working platform for loading material and a staging point for application procedures; also used as a safety barricade for tools or material that may fall from roof
- **nailer or stapler** — tool used to power-attach fasteners such as nails and staples

**NOTE:** Electric and pneumatic-powered nailers and staplers are available.



- **pointing trowel or margin trowel** — tool used to apply mastic
- **safety line** — line used as a personal safety device required on steep roofs
- **steel tape** — tool used to measure, check dimensions, and lay out work
- **toeboard** — a device, such as a 2 × 6, temporarily fastened across a sloping roof with toeboard jacks and used as a footing for workers
- **utility knife** — general purpose tool used to cut felt, insulation, shingles, and roll roofing

## OBJECTIVE 2

**From alternatives, choose the proper care and safety guidelines for the use of hand and power tools.**

**NOTE:** These are only a few of the many safety rules and guidelines for workers using tools. Always follow OSHA regulations and consult with your instructor or supervisor when necessary.

- Guidelines for care and safe use of tools
  - Use the correct tool for the job being done.
  - Keep tools clean, sharp, and in good condition.
  - Inspect tools and accessories regularly.
  - Repair broken or damaged tools promptly.
  - Dispose of broken or damaged tools that cannot be repaired.
  - Store tools properly.

**EXAMPLES:** Do not carry tools in your pockets; do not place tools where they can roll off; protect cutting edges; lightly oil tools before storing; store tools in a dry place.



- Stay alert when using tools.
  - Always wear a hard hat and eye protection.
  - Wear appropriate clothing for job being performed.
  - Do not ascend a ladder or stay on a roof during storms. Lightning and wind hazards exist during storms.
  - Use safety belts, safety lines, and toeboards on steep roofs or where appropriate (refer to OSHA regulations).
  - Be extremely careful to avoid tripping over tools, extension cords, air hoses, and lifelines when on a roof deck.
- Guidelines for the safe use of power tools and equipment.
    - Power tools
      1. Assume a safe and comfortable position before using a power tool.
      2. OSHA requires that GFCI circuits or other assured grounding system be used on all power tools and equipment. The GFCI circuit must be installed at the source of the AC.
      3. Keep a firm grip on the power tool while it is in use.
      4. Report or correct any condition that may lead to an accident.
      5. Report any unusual noises, sounds, or vibrations to the instructor or supervisor.
      6. Be sure that power tools are disconnected before performing maintenance or changing accessories.
      7. Do not work around electricity when you, your tools, the work surface, or the equipment are wet.



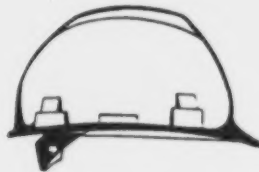
8. To avoid electrical shock, do not use metal ladders near electrical lines. Use wooden, fiberglass or other non-metallic ladder.
9. Read and follow operator's guide for the safe operation of hoisting equipment.
10. Do not distract co-workers while they are using power tools or equipment.

**OBJECTIVE 3**

**Given drawings, identify safety equipment and hand tools used for the installation of roofs. (Assignment Sheet 1)**

- Personal protection equipment
  - Hard hat

**FIGURE 1**



**NOTE:** Roofers must wear a non-metallic hard hat to avoid electrical hazards.

- Goggles

**FIGURE 2**



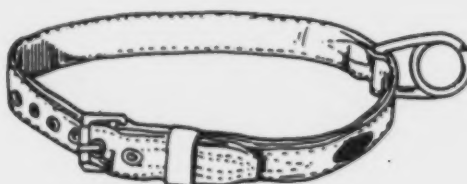
— Safety glasses

**FIGURE 3**



— Safety belts

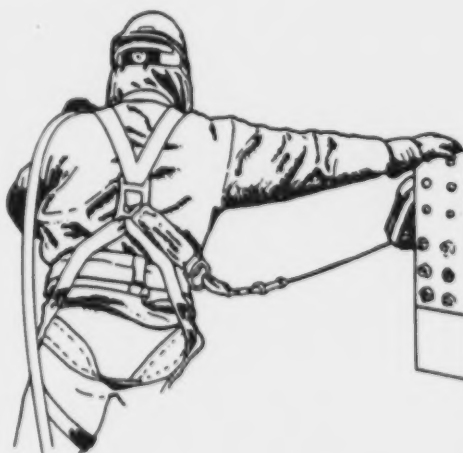
**FIGURE 4**



**NOTE:** Check OSHA regulations as to the allowable uses of this belt.

— Full-body harness

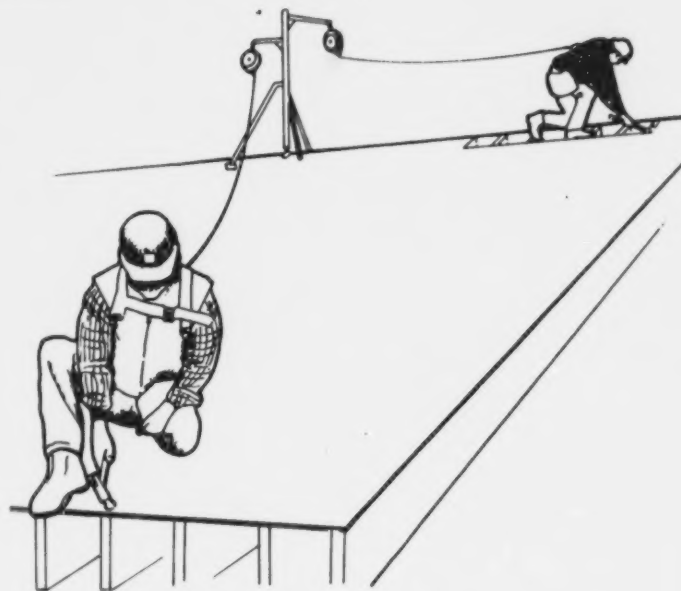
**FIGURE 5**





— Retractable lifelines

FIGURE 6



• Common hand tools

— Measuring and lay out devices

1. Rules

Steel tape

Chalk box  
and line

FIGURE 7

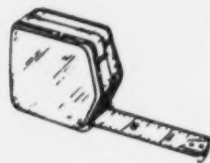


FIGURE 8



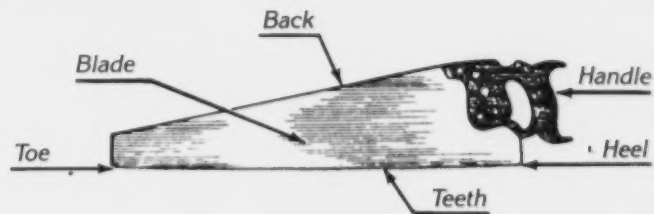
- Miscellaneous hand tools
  - Aluminum utility level line

FIGURE 9



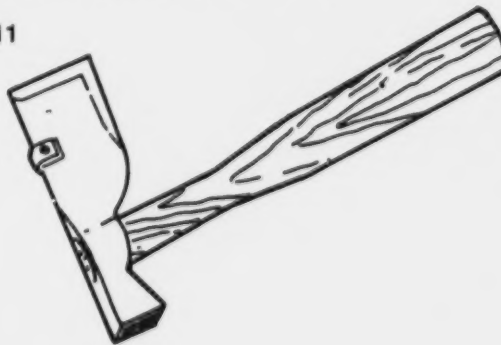
- Handsaw

FIGURE 10



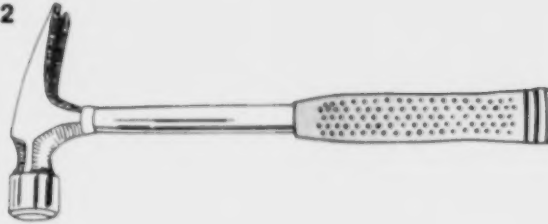
- Hatchet (roofer's or shingler's)

FIGURE 11



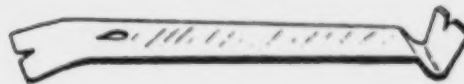
— Straight claw hammer

FIGURE 12



— Pry bar

FIGURE 13



— Utility knife

FIGURE 14



— Metal snips

FIGURE 15



• Shovels

— Scoop

FIGURE 16



— D-handled, square point

FIGURE 17



— Roofer's spade

FIGURE 18



— Phillips screwdriver

FIGURE 19



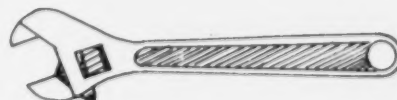
— Slotted screwdriver

FIGURE 20



— Adjustable wrench

FIGURE 21



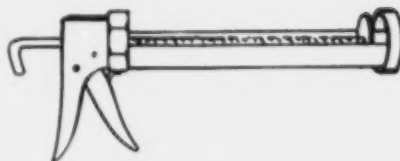
— Channel locks

FIGURE 22



— Caulking gun

FIGURE 23



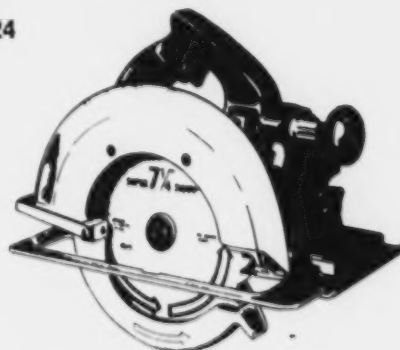
**OBJECTIVE 4**

**Given drawings, identify power tools and equipment used for the installation of roofs. (Assignment Sheet 2)**

• Power tools

— Circular saw

FIGURE 24



— Reciprocating saw

**FIGURE 25**



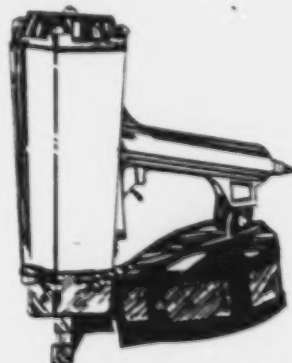
— ½-inch electric drill

**FIGURE 26**



— Electric or pneumatic nailer

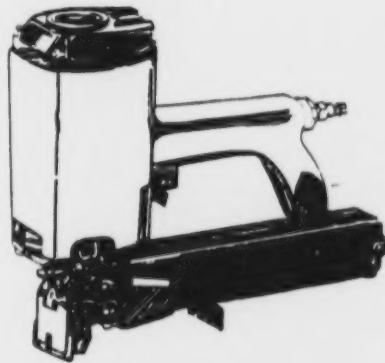
**FIGURE 27**



107

— Electric or pneumatic stapler

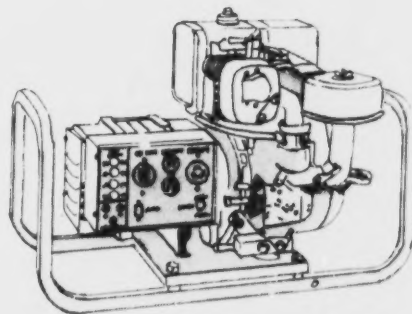
**FIGURE 28**



• Equipment

— Generator

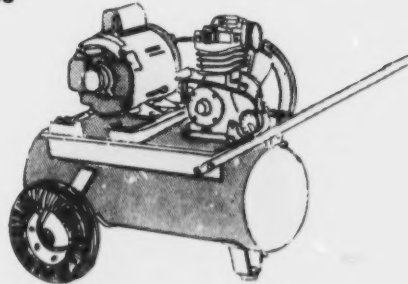
**FIGURE 29**





— Air compressor

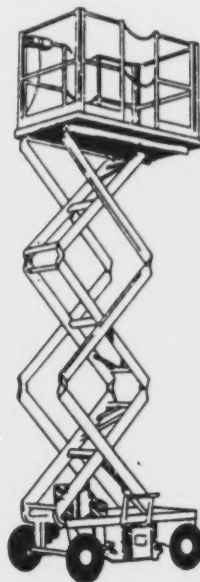
**FIGURE 30**



• Hoisting equipment

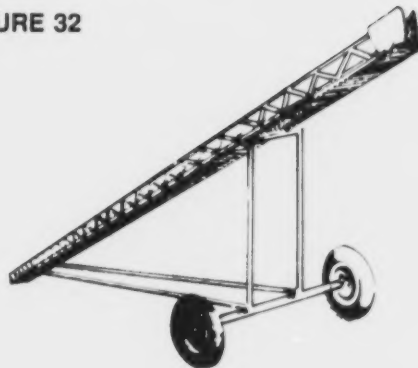
— Power lift

**FIGURE 31**



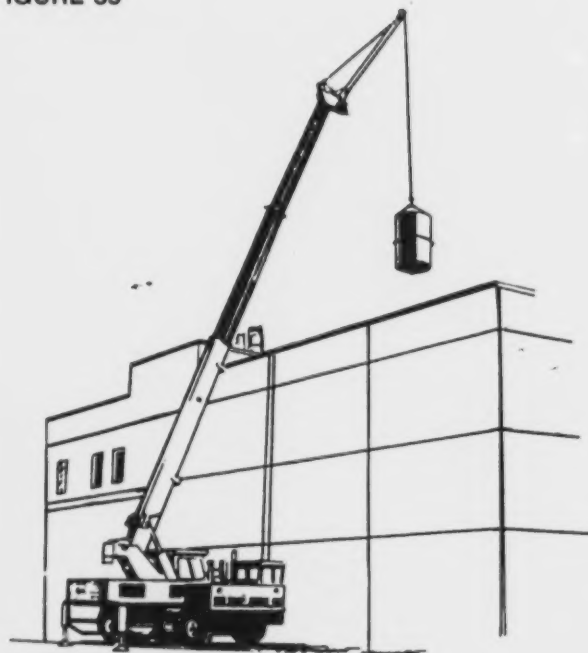
— Conveyor

FIGURE 32



• Hydraulic truck crane

FIGURE 33



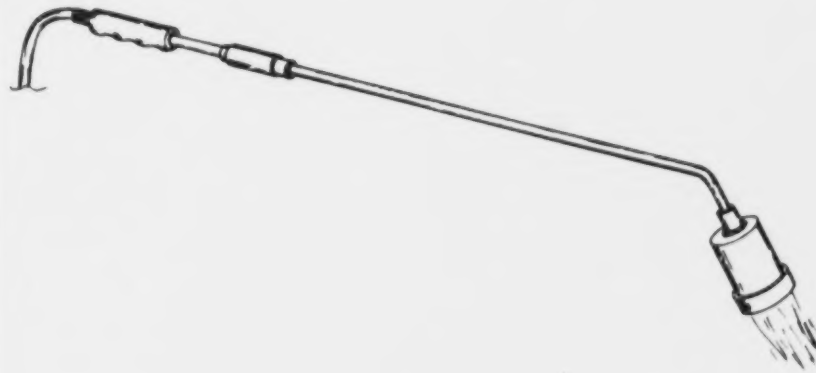
— Platform hoists (laddervator)

FIGURE 34



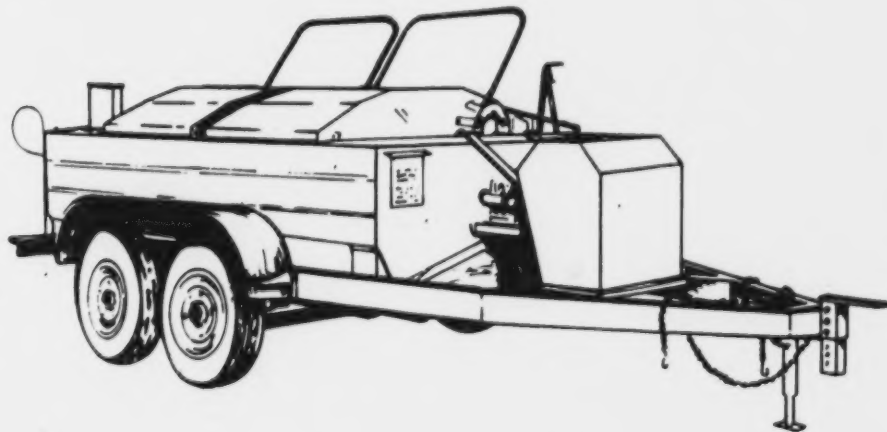
— Roofer torch

FIGURE 35



— Asphalt kettle

FIGURE 36



**ASSIGNMENT  
SHEET 1**

**ROOFING TOOLS  
AND EQUIPMENT**

**A 2**

Name \_\_\_\_\_ Score \_\_\_\_\_

**OBJECTIVE 3**

**Given drawings, identify safety equipment and hand tools used for the installation of roofs.**

**INTRODUCTION**

Practice the identification of common hand tools used to install roofing.

**INSTRUCTIONS**

Match by writing the tool title below each drawing.



Functional Reading  
• Use content area  
vocabulary

**Part A — Safety equipment**

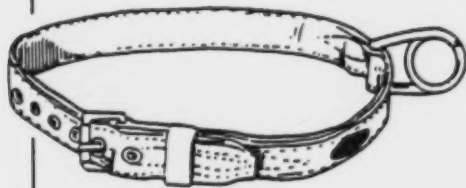
safety glasses  
hard hat  
retractable lifeline

full-body harness  
goggles  
safety belt

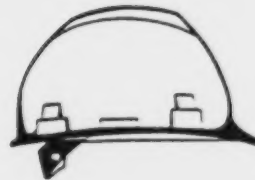


1. \_\_\_\_\_ 2. \_\_\_\_\_

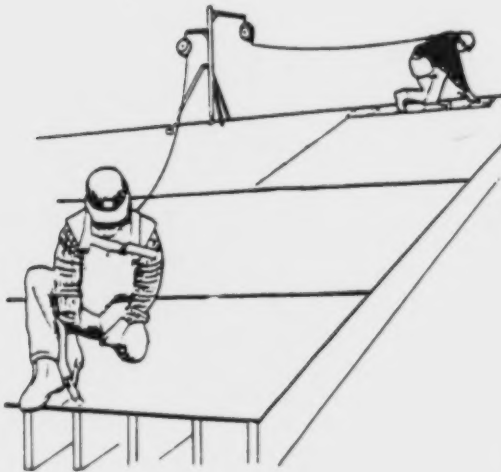




3. \_\_\_\_\_



4. \_\_\_\_\_



5. \_\_\_\_\_



6. \_\_\_\_\_

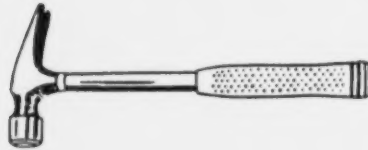


Part B — Hand tools

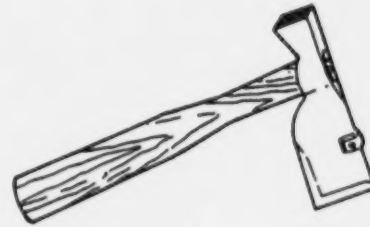
chalk box/line  
scoop shovel  
Phillips screwdriver  
pry bar  
aluminum level  
utility knife

adjustable wrench  
steel tape  
slotted screwdriver  
metal snips  
hatchet  
straight claw hammer

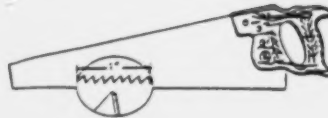
channel locks  
handsaw  
caulking gun  
D-handled,  
square point  
shovel



1. \_\_\_\_\_



2. \_\_\_\_\_

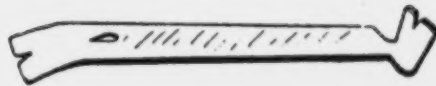


3. \_\_\_\_\_



4. \_\_\_\_\_





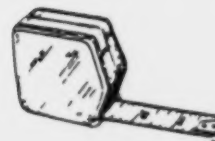
5. \_\_\_\_\_



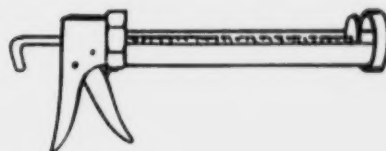
6. \_\_\_\_\_



7. \_\_\_\_\_



8. \_\_\_\_\_



9. \_\_\_\_\_



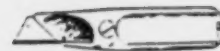
10. \_\_\_\_\_







11. \_\_\_\_\_



12. \_\_\_\_\_



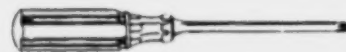
13. \_\_\_\_\_



14. \_\_\_\_\_



15. \_\_\_\_\_



16. \_\_\_\_\_



**ASSIGNMENT  
SHEET 2**

**ROOFING TOOLS  
AND EQUIPMENT**

**A 2**

Name \_\_\_\_\_ Score \_\_\_\_\_

**OBJECTIVE 4**

**Given drawings, identify power tools and equipment used for the installation of roofs. (Assignment Sheet 2)**

**INTRODUCTION**

Practice the identification of common power tools and equipment used in roofing.

**INSTRUCTIONS**

Match by writing the power tool or equipment title below the drawing.

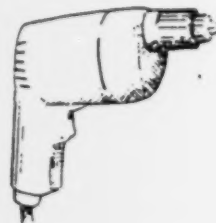
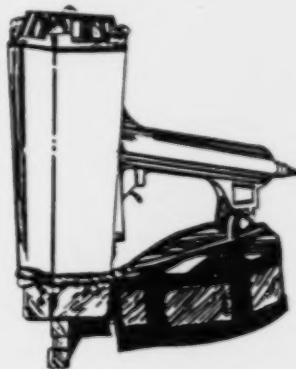


Functional Reading

- Use content area vocabulary

conveyor  
electric or pneumatic nailer  
circular saw  
½ inch electric drill  
alternator  
power lift

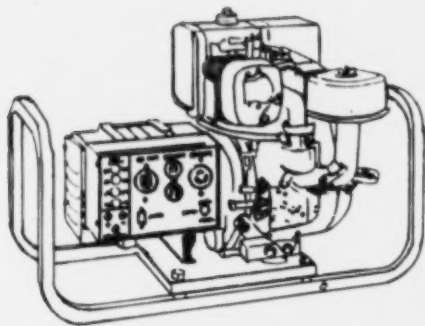
reciprocating saw  
air compressor  
electric or pneumatic stapler  
hydraulic truck crane



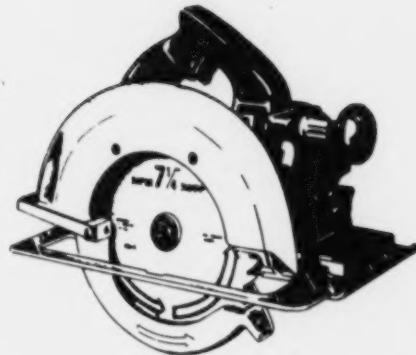
1. \_\_\_\_\_

2. \_\_\_\_\_

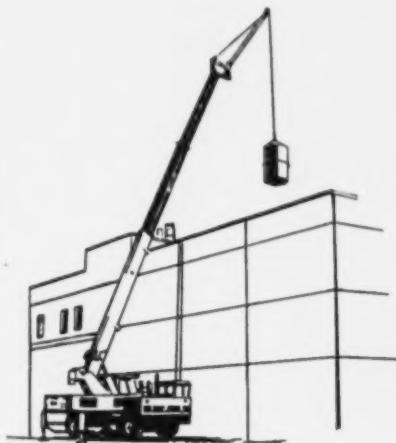




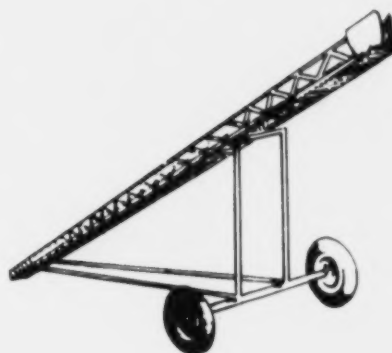
3. \_\_\_\_\_



4. \_\_\_\_\_

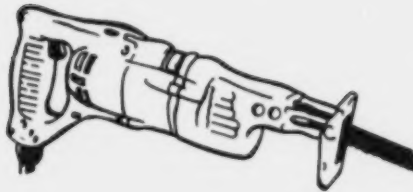


5. \_\_\_\_\_

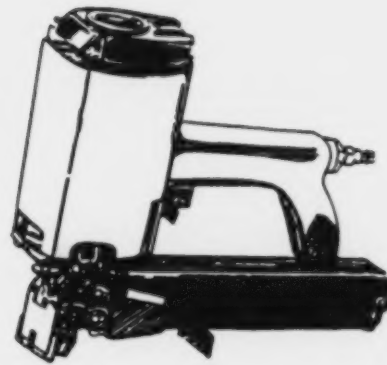


6. \_\_\_\_\_

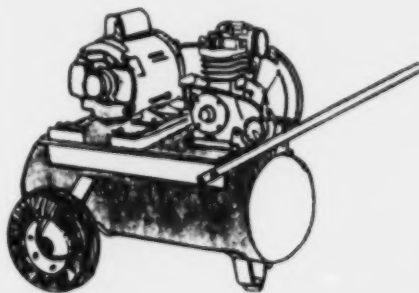




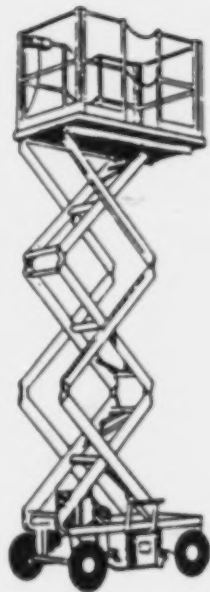
7. \_\_\_\_\_



8. \_\_\_\_\_



9. \_\_\_\_\_



10. \_\_\_\_\_



11. \_\_\_\_\_

**ASSIGNMENT  
ANSWERS****ROOFING TOOLS  
AND EQUIPMENT****A 2****ASSIGNMENT  
SHEET 1****Part A**

- |                   |                         |
|-------------------|-------------------------|
| 1. goggles        | 4. hard hat             |
| 2. safety glasses | 5. retractable lifeline |
| 3. safety belt    | 6. full-body harness    |

**Part B**

- |                         |                                   |
|-------------------------|-----------------------------------|
| 1. straight claw hammer | 9. caulking gun                   |
| 2. hatchet              | 10. scoop shovel                  |
| 3. handsaw              | 11. adjustable wrench             |
| 4. chalk box/line       | 12. utility knife                 |
| 5. pry bar              | 13. D-handled square point shovel |
| 6. channel locks        | 14. aluminum level                |
| 7. metal snips          | 15. slotted screwdriver           |
| 8. steel tape           | 16. Phillips screwdriver          |

**ASSIGNMENT  
SHEET 2**

- |                                 |                                  |
|---------------------------------|----------------------------------|
| 1. electric or pneumatic nailer | 6. conveyor                      |
| 2. ½ inch electric drill        | 7. reciprocating saw             |
| 3. alternator                   | 8. electric or pneumatic stapler |
| 4. circular saw                 | 9. air compressor                |
| 5. hydraulic truck crane        | 10. power lift                   |
|                                 | 11. platform hoist               |



**OBJECTIVE 5**

**Use a roofer's hatchet properly.**

**INTRODUCTION**

This exercise will allow you to practice the use of a roofer's hatchet to drive roofing nails.

**EQUIPMENT  
AND SUPPLIES**

- Hard hat and goggles
- Roofer's hatchet
- Roofing nails
- Plywood
- Asphalt shingles

**PROCEDURE**



Functional  
Reading Skills

- Follow written instructions



Job Acquisition/  
Development Skills

- Master specific job task/procedure

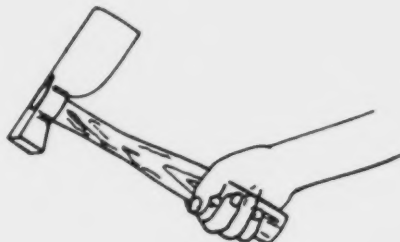
Yes    No

1. Put on hard hat and goggles. \_\_\_\_\_
2. Lay a sheet of plywood on a flat surface to simulate a roof deck. \_\_\_\_\_

**NOTE:** Ensure you place the plywood on a flat surface that will not be harmed by the nails protruding through the plywood.

3. Grasp the hatchet handle firmly near the end (Figure 38). \_\_\_\_\_

**FIGURE 38**



4. Position a shingle on the plywood.

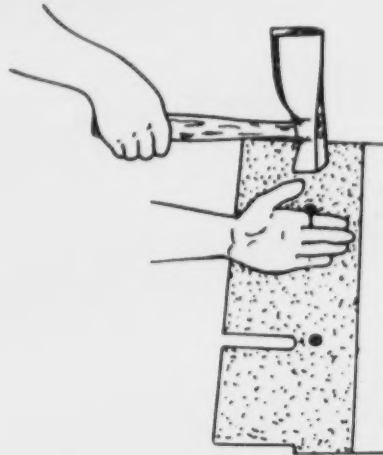
Yes No

\_\_\_\_\_

5. Rest the face of the hatchet head on the nail as you position the nail point on the shingle (Figure 39).

\_\_\_\_\_

FIGURE 39



6. Notice that the roofing nail should be placed between the index and middle fingers.

\_\_\_\_\_

7. Lean your head slightly to avoid the upper swing of the hatchet.

\_\_\_\_\_

8. Raise the hatchet head and lightly tap the nail to get it started (Figure 40).

\_\_\_\_\_

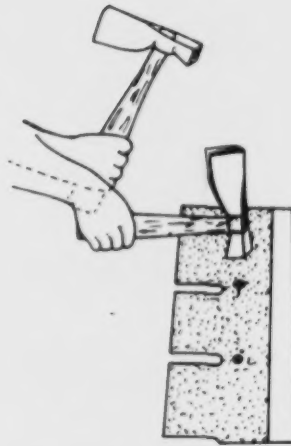
**NOTE:** This maneuver is accomplished through the wrist, elbow, and shoulder with one or all being used according to the strength of the blow to be struck.





Yes No

FIGURE 40



- |                                                                                                                 |       |       |
|-----------------------------------------------------------------------------------------------------------------|-------|-------|
| 9. With the nail started, pull your hand safely away from the nail.                                             | _____ | _____ |
| 10. Strike the nail squarely to drive the nail into the shingle and plywood.                                    | _____ | _____ |
| 11. Do NOT overdrive the nail head. It should be flush with the shingle surface and NOT break the shingle face. | _____ | _____ |
| 12. This concludes this job sheet. Ask your instructor to evaluate your work.                                   | _____ | _____ |

(End of Job Sheet)

### SKILL TEST RECORD

EVALUATOR'S  
COMMENTS

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**PRODUCT  
EVALUATION**

**Evaluator note:** Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

|                             |   |   |   |   |
|-----------------------------|---|---|---|---|
| Used safety equipment       | 4 | 3 | 2 | 1 |
| Grasped hatchet by end      | 4 | 3 | 2 | 1 |
| Started nail properly       | 4 | 3 | 2 | 1 |
| Drove nail straight         | 4 | 3 | 2 | 1 |
| Did not overdrive nail head | 4 | 3 | 2 | 1 |

**EVALUATOR'S  
COMMENTS**

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**AVERAGE  
RATING**

**Evaluator note:** To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

**PERFORMANCE  
EVALUATION KEY**

- 4 **Skilled** — Can perform job with no additional training
- 3 **Moderately Skilled** — Has performed job during training program; limited additional training may be required
- 2 **Limited Skill** — Has performed job during training program; additional training is required to develop skill
- 1 **Unskilled** — Is familiar with process, but is unable to perform job



**OBJECTIVE 6**

**Use a pneumatic fastener.**

**INTRODUCTION**

A pneumatic fastener can be very dangerous if not properly used. Its safe use greatly increases the effectiveness of the roofer. This exercise must be closely supervised by your instructor to ensure safe operation.

**EQUIPMENT  
AND SUPPLIES**

- Safety goggles and hard hat
- Pneumatic fastener
- Electric air compressor with air hose
- Fasteners (nails) designed for the fastener being used
- Two 2x4s, 4 feet long
- Manufacturer's instruction manual

**PROCEDURE**



Functional  
Reading Skills

- Follow written instructions



General  
Science Skills

- Investigate/apply technology

Physical  
Science Skills

- Investigate/apply physical laws

- |                                                                                                | Yes   | No    |
|------------------------------------------------------------------------------------------------|-------|-------|
| 1. Check to see that all safety devices are in place.                                          | _____ | _____ |
| 2. Plug air compressor into a power source.                                                    | _____ | _____ |
| 3. Put on safety goggles and hard hat.                                                         | _____ | _____ |
| 4. Start the air compressor.                                                                   | _____ | _____ |
| 5. Adjust the regulator to the pressure specified by the manufacturer for material being used. | _____ | _____ |
| 6. Load the fastener with nails.                                                               | _____ | _____ |



**CAUTION:** Never load the fastener with nails while attached to the compressor.





Job Acquisition/  
Development Skills

- Master specific job task/procedure
- Practice good work habits/attitudes

Yes No

7. Hold the fastener so that the discharge end is pointed down and away from anyone.

\_\_\_\_

8. Connect the air hose to the fastener.

\_\_\_\_



**CAUTION:** Be sure that both hands are clear of discharge end.

9. Check with your instructor for approval before using fastener.

\_\_\_\_

10. Check to see that everyone is clear of the fastener.

\_\_\_\_

11. Position the two pieces of stock to be fastened together.

\_\_\_\_

12. Position the fastener firmly on the stock to be connected and pull the trigger.

\_\_\_\_

13. Continue discharging nails until the project is complete.

\_\_\_\_

14. Disconnect air hose from the fastener.

\_\_\_\_

15. Turn off air compressor and disconnect it from the power source.

\_\_\_\_

16. Remove safety goggles and hard hat.

\_\_\_\_

17. Ask your instructor to evaluate your work.

\_\_\_\_



Yes No

18. Clean your work area and put away tools and equipment.

\_\_\_\_\_

(End of Job Sheet)

**SKILL TEST RECORD**

**EVALUATOR'S  
COMMENTS**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**PRODUCT  
EVALUATION**

**Evaluator note:** Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

|                                 |   |   |   |   |
|---------------------------------|---|---|---|---|
| Followed procedure instructions | 4 | 3 | 2 | 1 |
| Observed safety guidelines      | 4 | 3 | 2 | 1 |
| Completed task                  | 4 | 3 | 2 | 1 |

**EVALUATOR'S  
COMMENTS**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**AVERAGE  
RATING**

**Evaluator note:** To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

**PERFORMANCE  
EVALUATION KEY**

- 4 **Skilled** — Can perform job with no additional training
- 3 **Moderately Skilled** — Has performed job during training program; limited additional training may be required
- 2 **Limited Skill** — Has performed job during training program; additional training is required to develop skill
- 1 **Unskilled** — Is familiar with process, but is unable to perform job



**WRITTEN  
TEST**

**ROOFING TOOLS  
AND EQUIPMENT**

**A 2**

Name \_\_\_\_\_ Score \_\_\_\_\_

**OBJECTIVE 1**

**Given a list of terms associated with roofing tools, match them to their correct definitions. Write the letter that corresponds to the most correct answer.**

- \_\_\_\_\_ 1. A tool used to power-attach fasteners is a
- a. nailer or stapler
  - b. powered keel
  - c. jack nailer
  - d. GFCI
- \_\_\_\_\_ 2. A device, such as a 2x6, temporarily fastened across a sloping roof as a footing for workers is a
- a. toeboard
  - b. batter board
  - c. bracer
  - d. footer
- \_\_\_\_\_ 3. A tool used to cut flashing materials is a
- a. steel tape
  - b. utility knife
  - c. hatchet
  - d. combination tin snips
- \_\_\_\_\_ 4. A tool used to mark lines and dimensions is a
- a. steel tape
  - b. keel
  - c. square
  - d. raking pen





- \_\_\_\_\_ 5. Equipment that is used to move material from ground or a truck to a roof is
- a. hoisting equipment
  - b. GFCI devices
  - c. extension ladder
  - d. ladder jack
- \_\_\_\_\_ 6. A tool used to apply mastic is a/an
- a. pointing trowel
  - b. margin trowel
  - c. both a and b are correct
  - d. keel applicator
- \_\_\_\_\_ 7. A tool used to measure, check dimensions, and lay out work is a
- a. keel
  - b. steel tape
  - c. utility line
  - d. chalk box/line
- \_\_\_\_\_ 8. Personal safety device(s) required on steep roofs is/are
- a. scaffold plank
  - b. toeboards
  - c. safety line
  - d. both b and c are correct
- \_\_\_\_\_ 9. A tool used to space nails and cut shingles is a
- a. claw hammer
  - b. utility knife
  - c. shingles tape
  - d. hatchet
- \_\_\_\_\_ 10. Special circuits used to protect workers from electrical shock when using AC powered tools and equipment is
- a. safety box
  - b. keel
  - c. utility cords
  - d. GFCI





\_\_\_\_\_ 11. Equipment used in pairs to form a working platform for loading materials are

- a. ladder jacks and scaffold planks
- b. extension ladders
- c. toeboards
- d. barricades

\_\_\_\_\_ 12. A small box filled with a string line and colored chalk to mark a straight line is a

- a. 100 foot tape
- b. chalked tape
- c. chalk box/line
- d. string tape

**OBJECTIVE 2**

**From alternatives, choose the proper care and safety guidelines for the use of hand and power tools.**

\_\_\_\_\_ 1. During periods of lightning and/or high winds

- a. do not ascend a ladder
- b. do not stay on a roof
- c. do not use GFCI circuits on power tools
- d. both a and b are correct

\_\_\_\_\_ 2. When using hoisting equipment, you must

- a. read and follow operator's guides for their safe operation
- b. follow all OSHA guidelines for their safe use
- c. always wear a hard hat
- d. all the above are correct

\_\_\_\_\_ 3. When you discover a broken or damaged tool, you should

- a. repair or dispose of it promptly
- b. place the defective tool in your pocket
- c. store it in a dry place
- d. all the above



- \_\_\_\_\_ 4. When using an AC powered tool, be certain it is
- a. connected to an ungrounded AC outlet
  - b. connected to an AC circuit with an assured grounding system such as one equipped with GFCI
  - c. disconnected before performing maintenance
  - d. both b and c are correct
- \_\_\_\_\_ 5. When working around electricity or electrical lines
- a. use non-metallic ladders
  - b. be certain you, your tools, and equipment are dry
  - c. do *not* use metal ladders
  - d. all the above
- \_\_\_\_\_ 6. Which following safety guideline is true?
- a. Carry tools in your pocket.
  - b. Connect power tools when performing maintenance or changing accessories.
  - c. Do not distract co-workers while they are using power tools or equipment.
  - d. Ascend a ladder during a storm.
- \_\_\_\_\_ 7. While installing roofing, your electric nail gun becomes jammed. You should *first*
- a. try to remove the obstruction
  - b. disconnect the nail gun from AC power
  - c. remove your eye protection
  - d. lay the gun down and report the condition to a co-worker
- \_\_\_\_\_ 8. When roofing, you must
- a. wear a hard hat
  - b. wear eye protection
  - c. use safety belts, safety lines, and toeboards where appropriate
  - d. all the above



---

**NOTE:** Objectives 3-6 are evaluated on job sheets/assignment sheets in this unit. If you have not completed these components, see your instructor.

**WRITTEN TEST  
ANSWERS**

**ROOFING TOOLS  
AND EQUIPMENT**

**A 2**

**OBJECTIVE 1**

- |      |       |
|------|-------|
| 1. a | 7. b  |
| 2. a | 8. d  |
| 3. d | 9. d  |
| 4. b | 10. d |
| 5. a | 11. a |
| 6. c | 12. c |

**OBJECTIVE 2**

- |      |      |
|------|------|
| 1. d | 5. d |
| 2. d | 6. c |
| 3. a | 7. b |
| 4. d | 8. d |

# CIMC TEST CODE SHEET

VOCATIONAL PROGRAM (BOOK TITLE) *Introduction to Roofing*

UNIT NUMBER AND TITLE – A 2 Roofing Tools and Equipment

**TOTAL NUMBER OF TEST QUESTIONS 20**TOTAL NUMBER OF BASIC SKILL QUESTIONS 0[illegible]

| OBJECTIVE<br>SHEET     | APPLIED SKILLS <span style="float: right;">A 3</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| INTRODUCTION           | Roofers must safely apply roofing elements such as decking, underlayment, shingles, and flashing to both new and existing structures. This unit provides you the knowledge and skills to apply both asphalt and wood shingles.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| PREREQUISITE           | <i>Fundamentals of Construction</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| UNIT<br>OBJECTIVE      | After completing this unit, the student will be able to safely apply roofing elements. The student will demonstrate these competencies by completing the job sheets and written test with a minimum of 85 percent accuracy.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| SPECIFIC<br>OBJECTIVES | <p>After completing this unit, the student will be able to show the ability to:</p> <ol style="list-style-type: none"> <li>1. Given a list of terms associated with roofing skills, match them to their definitions.</li> <li>2. State the safety rules pertaining to roofing.</li> <li>3. Match minimum slope requirements to their specific roof applications.</li> <li>4. Given alternatives, choose the proper roof areas where flashing should be used.</li> <li>5. State guidelines for applying decking, underlayment, shingles, and flashing.</li> <li>6. Apply asphalt shingles with a 5-inch exposure. (Job Sheet 1)</li> <li>7. Apply wood shingles with a 5-inch exposure over spaced sheathing. (Job Sheet 2)</li> </ol> |



| SUGGESTED<br>ACTIVITIES | APPLIED SKILLS <span style="float: right;">A 3</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PREPARATION             | <ul style="list-style-type: none"> <li>• Review unit and plan presentation.</li> <li>• Order or obtain materials to supplement unit.</li> <li>• Introduce unit.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| DELIVERY                | <p><b>Objective 1: Given a list of terms associated with roofing skills, match them to their definitions.</b></p> <ul style="list-style-type: none"> <li>• Use the Information Sheet to discuss the terms.</li> </ul> <p><b>Objective 2: State the safety rules pertaining to roofing.</b></p> <ul style="list-style-type: none"> <li>• Show the film titled <i>Caught in Time</i>.</li> <li>• Put up safety posters emphasizing roofing safety.</li> <li>• Talk to your class about vertigo and fears of heights. Stress that no one with such problems will have to do roof work and that the problems are nothing to be ashamed of. Offer to get counseling or other help for those who want it.</li> <li>• Review lifting techniques and show the video titled <i>Back to Basics: Back Injury Prevention</i>.</li> </ul> <p><b>Objective 3: Match minimum slope requirements to their specific roof applications.</b></p> <ul style="list-style-type: none"> <li>• Discuss slope requirements.</li> <li>• Use Transparency 1 to reinforce your discussion.</li> </ul> <p><b>Objective 4: Given alternatives, choose the proper roof areas where flashing should be used.</b></p> <ul style="list-style-type: none"> <li>• Discuss the requirements for applying flashing and the areas where flashing should be used.</li> </ul> |





- Show the class Transparencies 2 through 5.
- Visit construction sites to see flashing in place and being installed.
- Demonstrate the cutting and shaping of flashing, emphasizing safe practices.
- Discuss sealant requirements and demonstrate the application of sealants.

**Objective 5: State guidelines for applying decking, underlayment, shingles, and flashing.**

- Use the Information Sheet to discuss applying decking.
- Discuss guidelines for applying underlayment.
- Use Transparency 6 to reinforce your discussion.
- Discuss applying wood and asphalt shingles. Use Transparencies 7 and 8 to supplement your discussion.

**APPLICATION**

**Objective 6: Apply asphalt shingles with a 5-inch exposure.**  
(Job Sheet 1)

- Explain that fiberglass shingles would be applied in a similar manner.
- Show video titled *Roofing*.

**Objective 7: Apply wood shingles with a 5-inch exposure over spaced sheathing.** (Job Sheet 2)

- Allow students to practice the procedures in the job sheets.

**EVALUATION**

**Pretest**

- Give written test as pretest.
- Determine individual study requirements from pretest results.





- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

#### **Skill Test**

- Evaluate students on job sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

#### **Written Test**

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give the written test.

**NOTE:** The written test may be given in sections if desired.

- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

#### **SUGGESTED RESOURCES**

##### **Electronic Media**

- *Caught In Time: Fall Protection In the Construction Industry.* AGC of America, 202-393-2040, ext. 287, VHS video, 16 minutes.
- *Back to Basics: Back Injury Prevention.* AGC of America, 202-393-2040, ext. 287, VHS, video, 16 minutes.

UNIT  
REFERENCES

- *Roofing (V107)*. Oklahoma Department of Vocational and Technical Education, 1500 W. Seventh Avenue, Stillwater, OK 74063, VHS video, 42 minutes.
- Ball, John. *Exterior and Interior Trim*. Delmar Publishers, Albany, NY.
- Toenjes, Leonard P. *Building Trades Dictionary*. American Technical Publishers, Inc.: Homewood, IL 60430.
- Watson, John. *Roofing Systems: Materials and Applications*. Reston Publishing, Reston, VA.
- Willey, Al. *Commercial Carpentry*. Stillwater, OK: Oklahoma Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and the Associated General Contractors of America. 1993.



**INFORMATION  
SHEET**

**APPLIED SKILLS**

**A 3**

**OBJECTIVE 1**

**Given a list of terms associated with roofing skills, match them to their definitions.**

- **break** — in roofing, a break is the staggering of the positions of shingle tabs; this process improves water flow and enhances the patterns formed by shingles
- **built-up roofing** — a term used to describe roofs made up of several layers of water resistant materials applied in an overlapping manner
- **counterflashing** — a metal sheet that is installed in a masonry joint and bent downward over a base flashing; it prevents water from entering the joints
- **course** — a horizontal row of roof shingles
- **cricket** — see saddle
- **exposure** — the visual portion of a shingle after installation
- **load bearing capacity** — the amount of weight that can safely be supported by the roof
- **load lifting limit** — the maximum amount of weight that can be hoisted by the lifting equipment being used
- **nailing pattern** — the positioning of fasteners that will best secure roofing materials and reduce the risk of roof leaks
- **saddle** — a projection of the roof on the upper side of a chimney or other structure; it is used to divert water around the structure. It is also called a cricket
- **self-sealing strip** — a strip of adhesive that has been preapplied to shingles at the factory; the adhesive is heat activated and once the shingle is installed, it helps seal the roof surface from moisture and wind



- **spaced sheathing** — Although plywood decking is common, some structures use lumber such as 1×2's for roof decking. These 1×2's are installed with voids or spaces between them to improve air flow below shingles
- **starter course** — the initial or lowest course of shingles; the starter course is fastened in a reverse direction from the remaining courses and overlapped to provide a waterproof seal

## OBJECTIVE 2

**State the safety rules pertaining to roofing.**

**NOTE:** Follow all OSHA rules and regulations.

- Rules for appropriate dress
  - Wear goggles.
  - Wear hard hat
  - Wear ankle-high work shoes or boots with non-skid soles.
  - Wear gloves as required.
  - Wear protection against the elements (to prevent frostbite, sunburn, or sunstroke).
  - Wear fall protection equipment as required.
- Rules for ladder safety
  - Don't ascend a ladder while carrying a load.
  - Inspect ladders before they are sent to the job site.
  - Select the right ladder for the job.

**EXAMPLE:** On a building 16 feet high, a standard 28-foot extension ladder is best for the job since the base of the ladder has to be away from the building 1 foot for every 4 feet of building height and still reach a minimum of 3 feet above the eave of the roof.



- Tie off ladders at top.
- Be sure all ladders are equipped with safety shoes.
- Secure ladders at bottom if they extend more than 3 feet above roof line.
- General safety rules
  - Stay within load limits of equipment being used.
  - Do *not* let anyone walk under load that is being hoisted.
  - Use toeboard (also called footrest or foothold) to prevent worker slippage when working on steeper roofs.
  - Be careful to ensure the roof will hold your weight. Some existing roofs may be weakened by water or wind damage.
  - Never overload one section of roof with materials; distribute materials evenly over entire roof area.
  - Lift heavy materials correctly.
  - Never carry utility knife in your pocket; keep knife in its holster.
  - Handle hatchets carefully.
  - Do not use power fasteners until you have read manufacturer's instructions and passed safety test.
  - Use GFCI circuits or other assured grounding method on all AC circuits used with AC powered tools and equipment. The circuits must be installed at the power source.
- Rules for use of scaffolds.
  - Observe OSHA regulations.
  - Use only approved scaffolding.



- Inspect scaffolds regularly.
- Install all braces and accessories according to manufacturer's recommendations.
- Install anchors and guy wires on freestanding scaffolds as required.
- Keep scaffolds plumb and level.
- **Do not** over load scaffolds.
- Be sure all safety rails are installed according to OSHA regulations.
- Be sure wheels are locked before ascending a rolling scaffold.
- Always check for electrical wires and disengage wires before erecting metal scaffolds in the vicinity.
- **Do not** work on scaffolds during storms or high winds, or when scaffolds are covered with ice or snow.

### OBJECTIVE 3

#### **Match minimum slope requirements to their specific roof applications.**

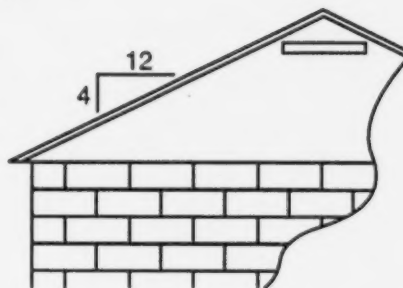
- Slope — As a review, the slope is the incline of a roof as a ratio of vertical rise to horizontal run, also referred to as the pitch of a roof (Figure 1).

**EXAMPLE:** If the roof rises at the rate of 4 inches for each foot of run, it is designated as having a 4 in 12 slope.





FIGURE 1



- Minimum slope requirements for specific roofing applications
  - From flat to 1 in 12 — Use built-up roofing
  - From 1 to 2 in 12 — Use roll roofing with concealed nails or double-coverage roll roofing
  - From 2 to 3 in 12 — Use roll roofing with exposed nails
  - From 3 in 12 to vertical — Use any style of shingle roofing

**OBJECTIVE 4**

**Given alternatives, choose the proper roof areas where flashing should be used.**

**NOTE:** Flashing must be used wherever there is a change in roof slope, where there is a roof opening, or where there is a projection from the roof surface.

- Valleys
- Vertical walls
- Chimneys
- Vent stacks
- Crickets/saddles
- Roof vents
- Skylights



## OBJECTIVE 5

### State guidelines for applying decking, underlayment, shingles, and flashing.

- Applying decking

- Selection of material

The building specifications will state the type of decking or sheathing and the fastener type required to meet or exceed local building codes.

The most common roof sheathing material is plywood. Plywood should be no less than  $\frac{1}{2}$ " thick and be of exterior grade to resist moisture.

- Application guidelines

**NOTE:** Normally, the roof decking is installed during the framing process in new construction. In some areas, roofers may replace existing roof decks while re-roofing an existing structure.

1. Use all appropriate personal protection equipment and follow OSHA safety guidelines.
2. Lay out the position of the first row of plywood by marking the rafter with a chalk line. The lowest or bottom row of decking should be applied first.
3. Leave  $\frac{1}{8}$ " space at the side and  $\frac{1}{4}$ " space on the ends of the plywood to serve as expansion joints.
4. Stagger the plywood joints by starting the second row with  $\frac{1}{2}$  sheet.
5. Use fasteners, such as nails, screws, and/or clips as specified by the building plan.
6. Fasten the sheets to the rafters using full plywood sheets. Let them extend above the ridge and over the gable ends.
6. Mark the excess overhanging plywood and carefully cut with a circular saw.



- Applying underlayment

**NOTE:** The most common roofing underlayments are asphalt and saturated felt. Underlayment provides an additional barrier against moisture, wind, and wind-driven snow.

- Lap top of underlayment at least 2 inches.
- Lap sides and end of underlayment at least 4 inches.
- Lap each side of center line at least 6 inches on hips and valleys.

- Applying shingles

- Wood shingles

1. Use all appropriate personal protection equipment and follow all OSHA safety guidelines.
2. Double shingles at eaves and stagger shingles at joints.
3. Extend first and starter courses a minimum of 1½ inches beyond finished fascia board or last sheathing board and 1 inch at gable ends.

**NOTE:** Reduce the extension (overhang) to 1 inch when gutters or eave troughs are used.

4. Install shingles so that space between adjacent shingles (joint or slots) is no less than ¼ inch and not more than ¾ inch.

**NOTE:** If shingles are wet, use smaller spacing; if shingles are dry, use larger spacing.

5. Stagger joints in one course at least 1½ inches from joints in adjacent course. This is often called double breaking.

**NOTE:** Joints in alternate courses should not be in direct alignment.

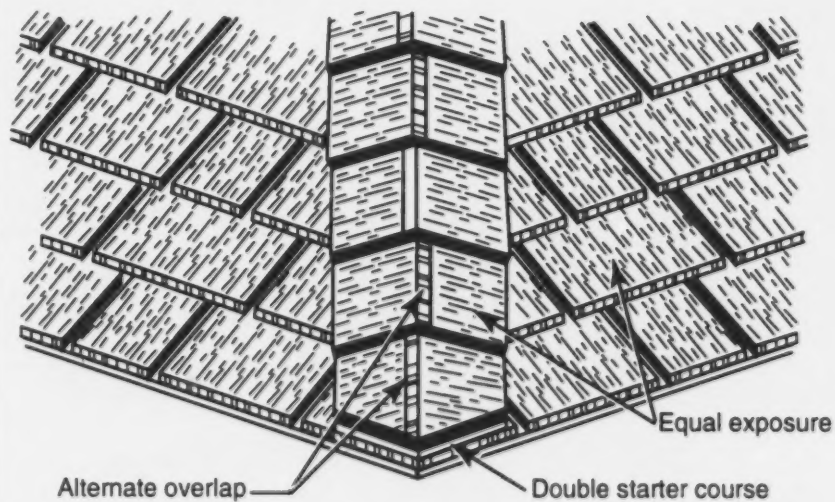
6. Drive one nail no more than  $\frac{3}{4}$  inch from each side of shingle and no more than  $1\frac{1}{2}$  inches above shingle's exposure line.

**NOTE:** Use no more than two nails, regardless of the width of the shingle.

7. Drive each nail so that head is flush with shingle surface; *do not* drive head into wood fiber.
8. Cover hips and ridges with shingles that have a uniform width of 3 inches to 5 inches.
9. Attach hip and ridge shingles with alternate overlaps and with an exposure to that of all preceding courses (Figure 2).

**NOTE:** Manufactured hip and ridge units are available for use and are recommended for an economical and uniform application.

**FIGURE 2**



— Asphalt shingles

1. Use all appropriate personal protection equipment and follow all OSHA safety guidelines.
2. Install underlayment.
3. Cut and install the metal drip edge along the eaves and gable ends.
4. Install flashing in appropriate locations.
5. Apply the double starter course;

- a. Apply first row of asphalt shingles of 9-inch strip of mineral-surfaced asphalt roll roofing along eave of roof.

**NOTE:** When applying the starter course of self-sealing shingles, the exposed tab portion of the shingle may be cut off and the shingle applied so that the self-sealing strip is at or nearest the eave.

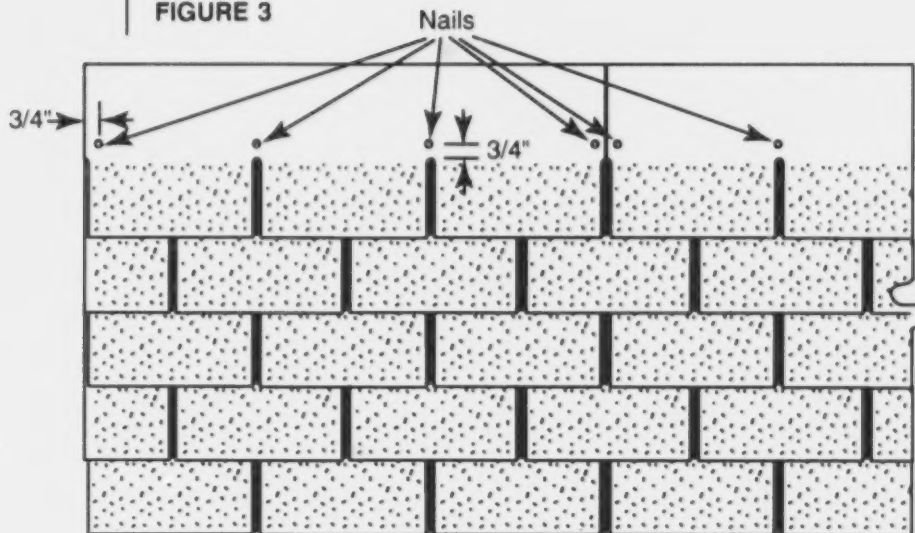
- b. Apply second row of shingles so that it overlaps bottom edge of eave as recommended by manufacturer.
  - c. Fasten starter course with roofing nails along a line that is parallel to and 3 to 4 inches above edge of eave.
  - d. Space nails so that nailheads will not be exposed after first course of shingles is applied.
6. Apply successive courses.

**NOTE:** The guidelines given below are for shingles that are made so that the cut-outs are centered on the tabs of the shingles in the course below. Various methods are used to apply this type of shingle. See manufacturer's recommendations on packages. Also, these guidelines apply to courses above the starter course.



- a. Nail each shingle with four roofing nails: one  $\frac{3}{4}$  inch above each cutout and one at each end approximately  $\frac{3}{4}$  inch in from the edge of shingle (See Figure 3).

FIGURE 3



- b. Start first course with a full shingle, and apply all shingles so that lower edges of butts are aligned with bottom edge of starter course (See Figure 4).
- c. Start second course with a full shingle minus one-half tab, and apply all shingles so that lower edges of butts are aligned with top of cutouts of underlying course (See Figure 4).

**NOTE:** Cut 6 inches from the first shingle to eliminate one-half tab.

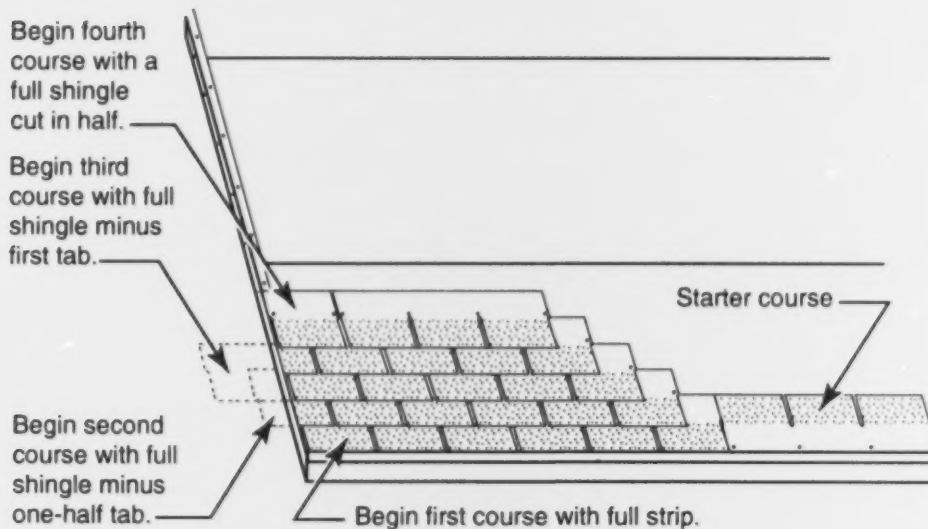
- d. Start third course with a full shingle minus first tab, and apply all shingles so that lower edges of butts are aligned with top of cutouts of underlying course (See Figure 4).

**NOTE:** Cut 12 inches from the first shingle to eliminate first tab.



- e. Start fourth course with a full shingle cut in half, and apply all shingles so that lower edges of butts are aligned with top of cutouts of underlying course (See Figure 4).

FIGURE 4



7. Apply remaining rows of shingles and attach hip and ridge with shingles.

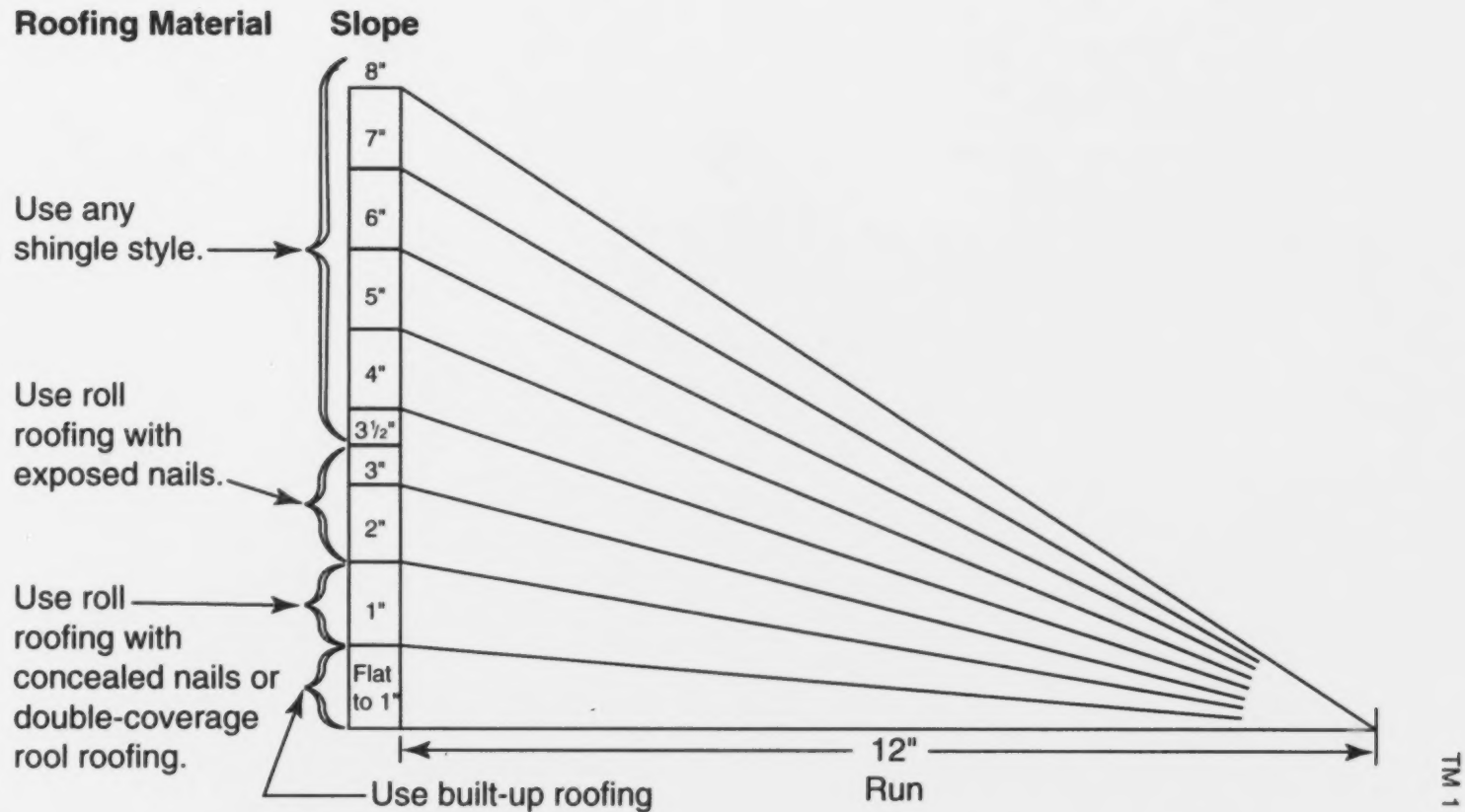
- Applying flashing

- Apply valley and edge flashing before applying shingles.
- Apply flashing at all intersections of different roof planes, all abutments of roof against adjoining walls, and all projections through roof surface.

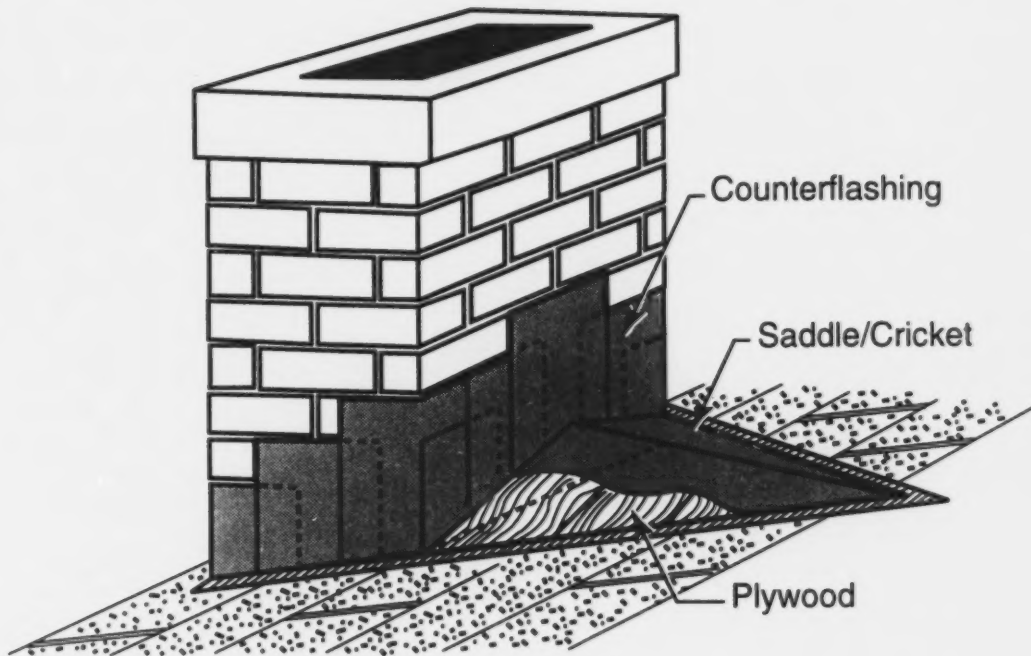
**NOTE:** Flashing seals the roof against leakage.

- Apply flashing so that descending water will be carried over a joint, *not into it*.

# Minimum Slope Requirements for Various Roof Applications

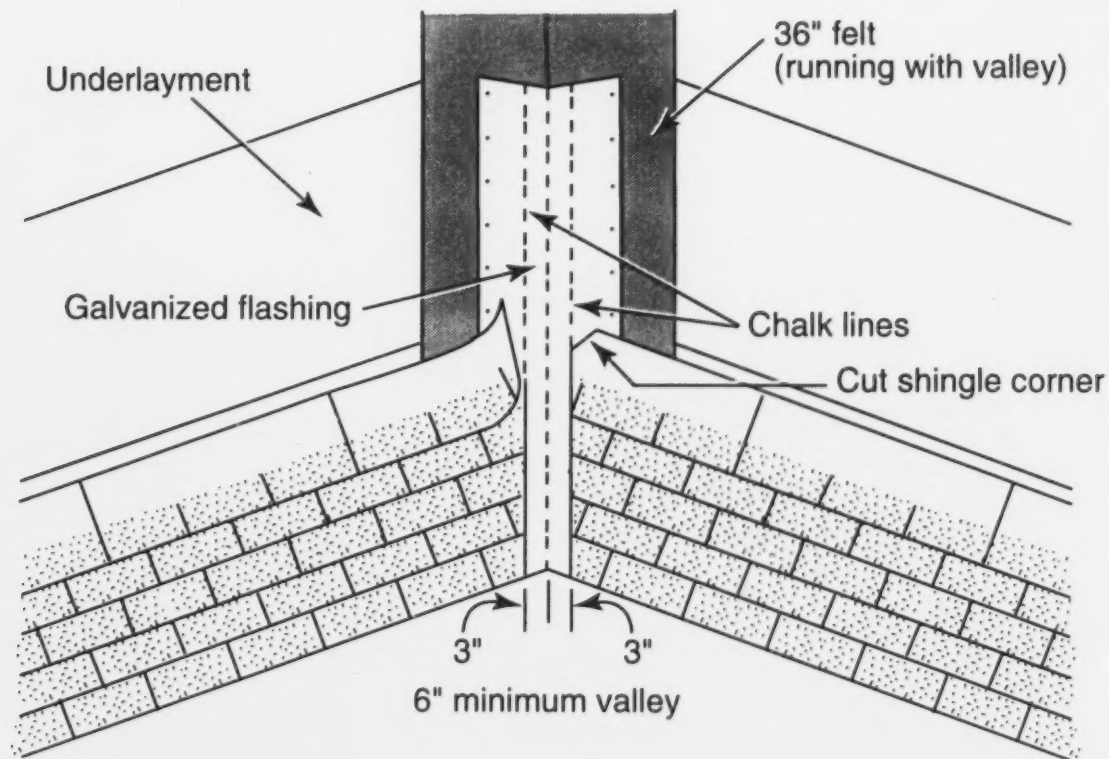


# Chimney Flashing



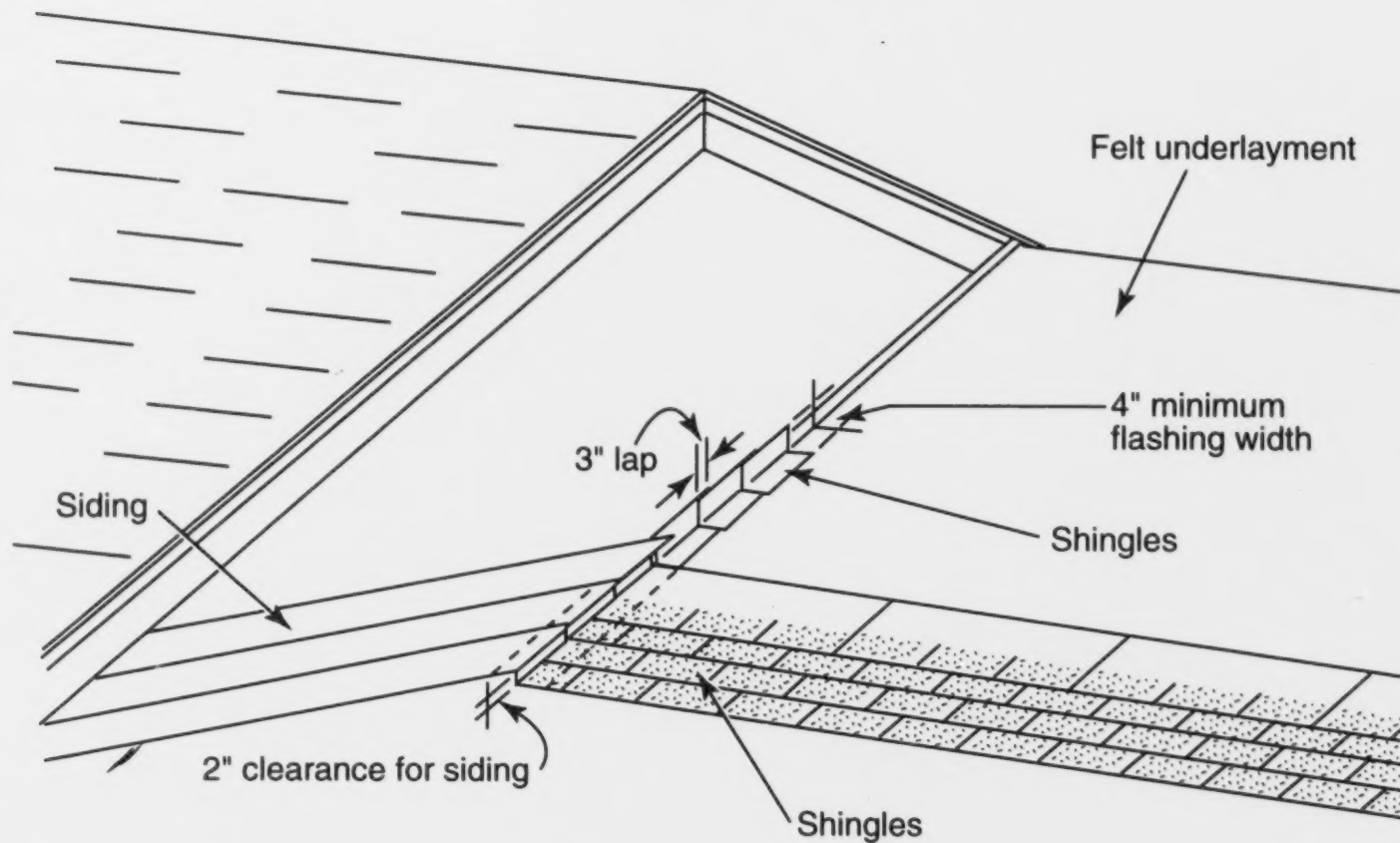


# Open-Valley Flashing





# Flashing at Wall Intersection



TRANSPARENCY MASTER 4 - Introduction to Roofing  
CIMC - A 3 - 25

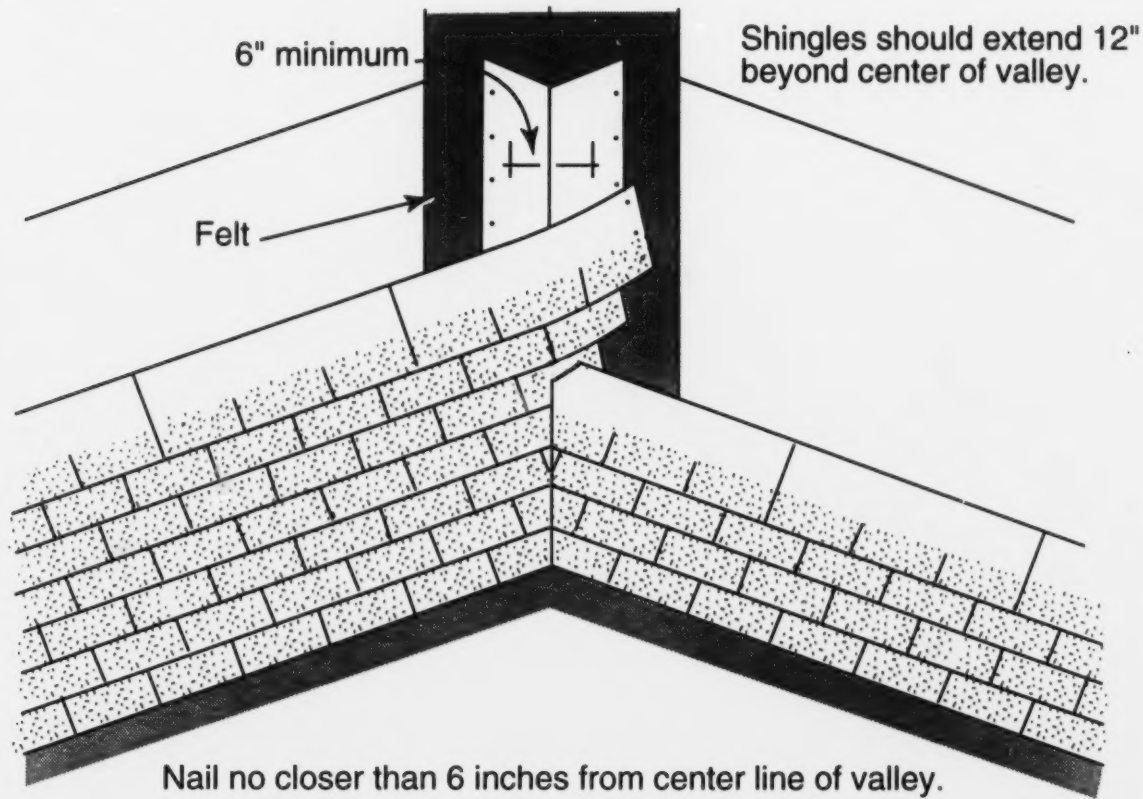


159

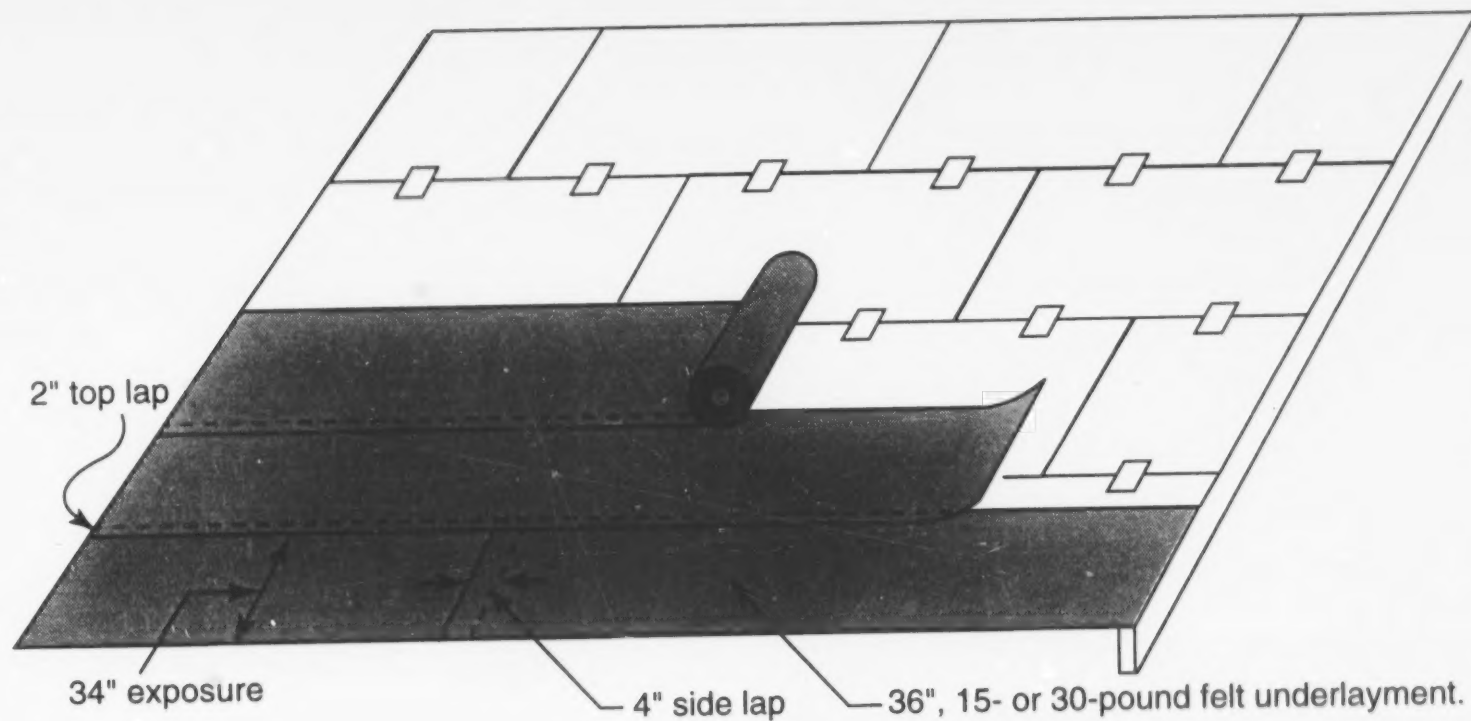
160

TM 4

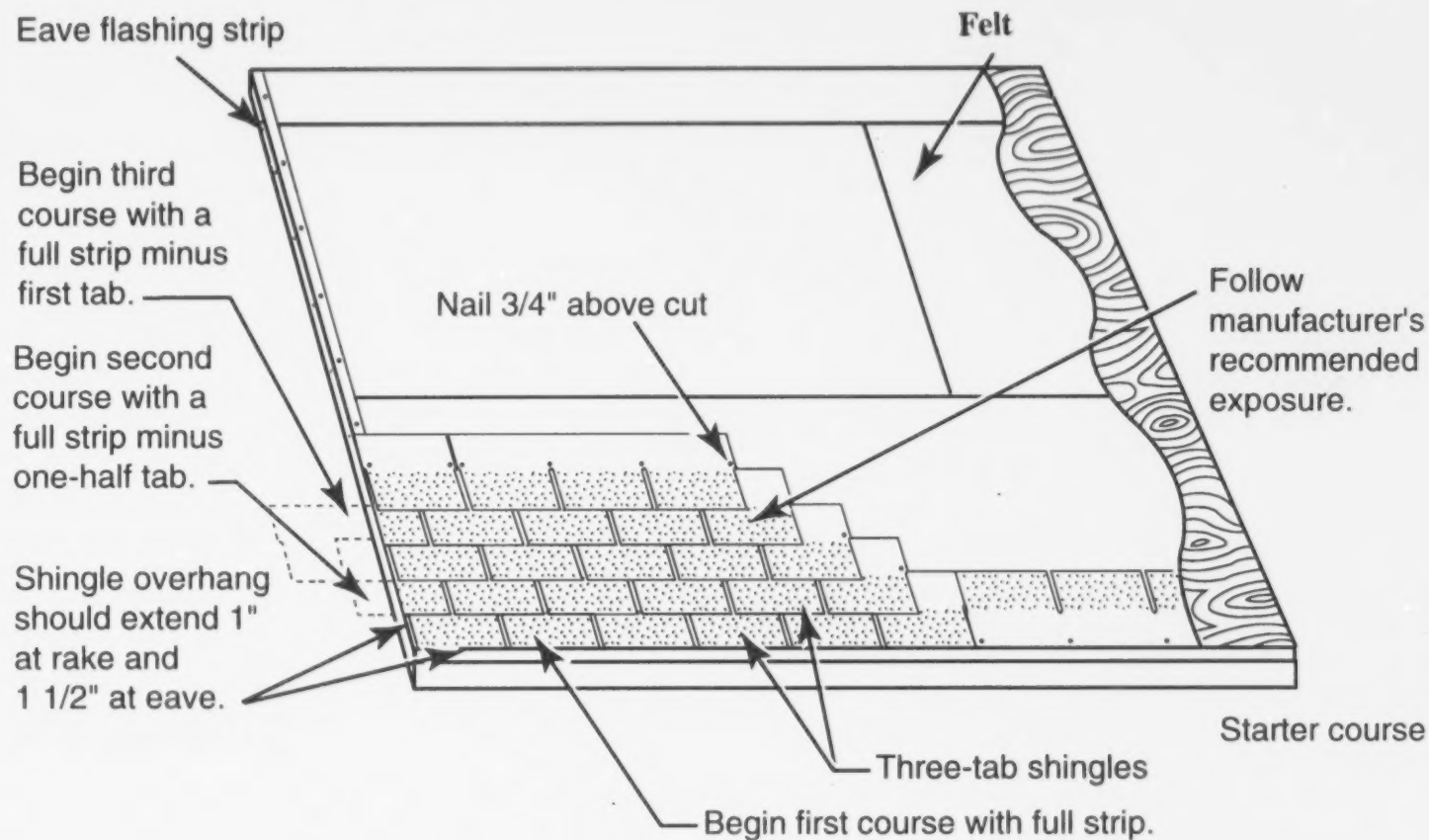
# Closed-Valley Flashing with Asphalt Shingles



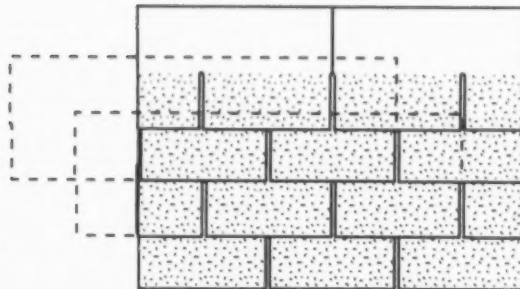
## Underlayment Installation



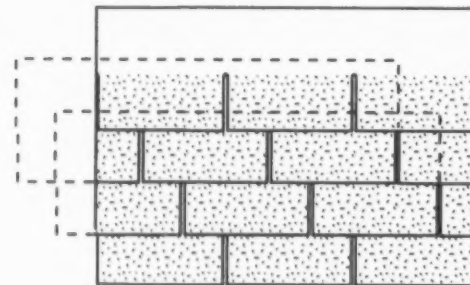
# One-Half Break Asphalt-Shingle Installation Pattern



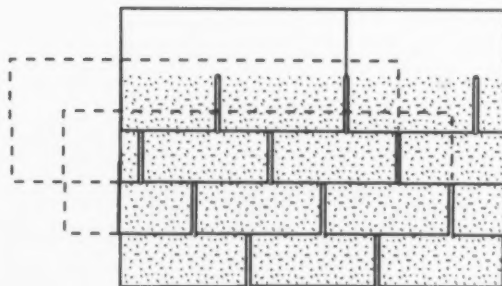
# Asphalt-Shingle Installation Patterns



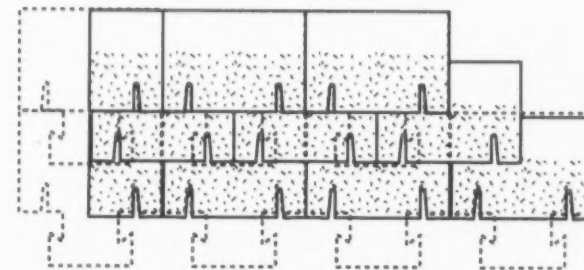
One-half break,  
tab pattern



One-third break,  
three-tab pattern



5-inch break,  
three-tab pattern



Lock-tab pattern

**OBJECTIVE 6**

**Apply asphalt shingle with 5-inch exposure.**

**EQUIPMENT  
AND SUPPLIES**

- Safety goggles and hard hat
- Roofer's hatchet
- Utility knife
- Margin trowel
- Plastic cement
- Prefabricated pipe flashing (single piece)
- Shingles and manufacturer's instructions
- Roofing nails
- Metal drip edge
- Underlayment material

**NOTE:** Some shingle manufacturers provide metric measured singles. Check with the manufacturer for instructions and exposure measurements.

**PROCEDURE**



Research and  
Reference Skills

- Use standard references

Functional  
Reading Skills

- Follow written instructions
- Interpret graphics and symbols



Math Application Skills

- Use English and metric measures

**For applying underlayment over sheathing (dry-lin).**

Yes No

1. Put on safety goggles and hard hat. \_\_\_\_\_
2. Apply full width of underlayment (3 feet) along eave, placing lower edge and end of underlayment flush with sheathing over eaves and rake. \_\_\_\_\_
3. Nail underlayment  $\frac{1}{2}$  or  $\frac{3}{4}$  inch down and in a straight line from top edge of underlayment, spacing nails about 18 inches apart. \_\_\_\_\_

**NOTE:** This nailing pattern will secure the top edge of the underlayment until the next underlayment course is laid.

4. Nail underlayment about 1 inch from edge of sheet along eaves and rake, spacing nails about 12 inches apart. \_\_\_\_\_





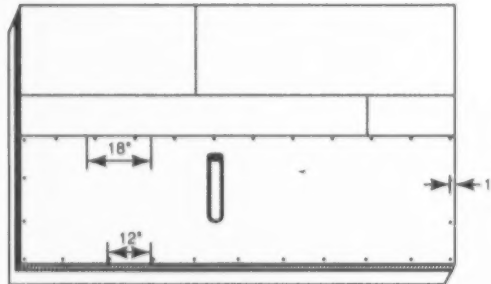


- Job Acquisition/  
Development Skills
- Master specific job task/procedure

Yes No

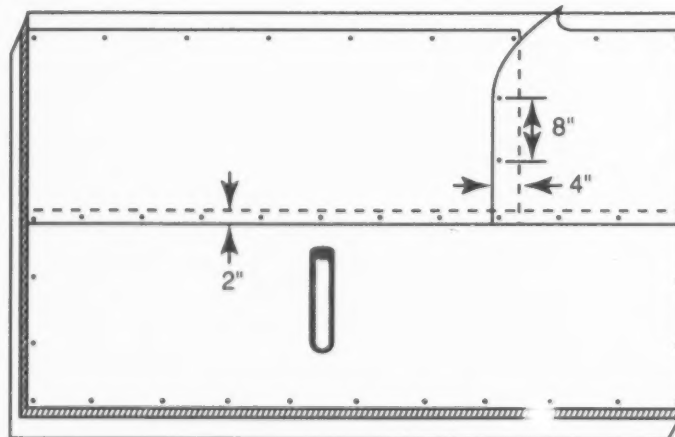
**NOTE:** Lap underlayment 4 inches if splices are required.

**FIGURE 5**



5. Apply second underlayment course, following procedures in steps 3 and 4 and lapping second course 2 inches down over first course.
6. Continue applying underlayment, following procedures outlines in steps 3 and 4 and maintaining proper laps until entire roof is covered.

**FIGURE 6**



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# PROCEDURE

## For applying shingles.

Yes No

### 1. Install metal drip edge.

- a. Put one nail about 1/2 inch from center at each end of drip edge and another nail down about 3/4 inches from top edge.
- b. Space nails about 10 inches apart down length of drip edge.

\_\_\_\_\_

\_\_\_\_\_

### 2. Apply double starter course (See Figure 7).

- a. Apply first row of starter course so that top edge is down and even with edge or eave.
- b. Apply second row of starter course so that it overlaps bottom edge of eave as recommended by manufacturer.

\_\_\_\_\_

\_\_\_\_\_

### 3. Apply first course of shingles (See Figure 7).

- a. Determine pattern to be used.

\_\_\_\_\_

EXAMPLES: One-half tab break,  
one-third tab break,  
5-inch break

- b. Follow manufacturer's recommendations for layout and installation.

\_\_\_\_\_

**NOTE:** Often manufacturers will give installation instructions on the package. These instructions should be followed exactly. Use the recommended nailing pattern, checking to see whether or not different nailing patterns are required for different pitches. Also, manufacturers may specify gap between abutting edges of shingles or other procedures.





Yes No

4. Apply second course of shingles, following procedure determined for first course until you get to vent pipe.

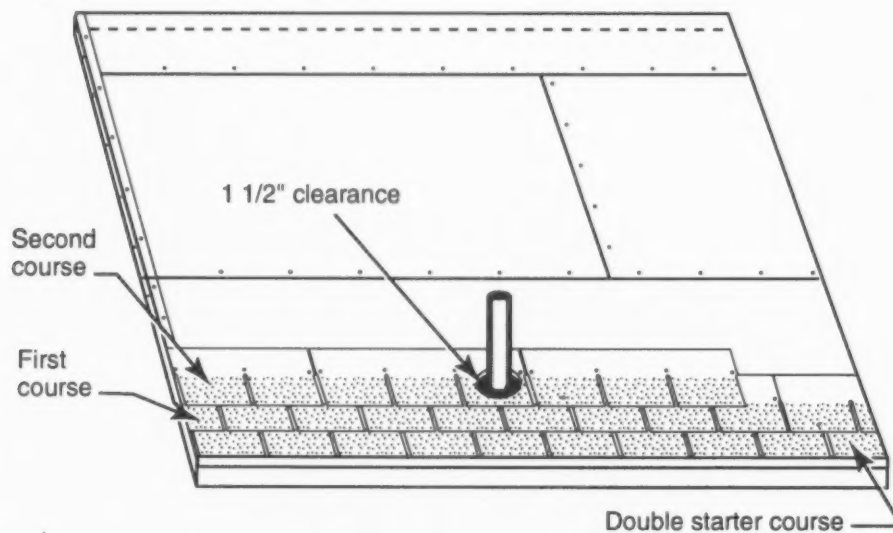
\_\_\_\_\_

5. Make cutout for vent pipe and install flashing.

a. Cut and fit shingle around vent pipe, allowing about 1½-inch clearance.

\_\_\_\_\_

FIGURE 7



b. Apply shingle and nail in place (See Figure 7).

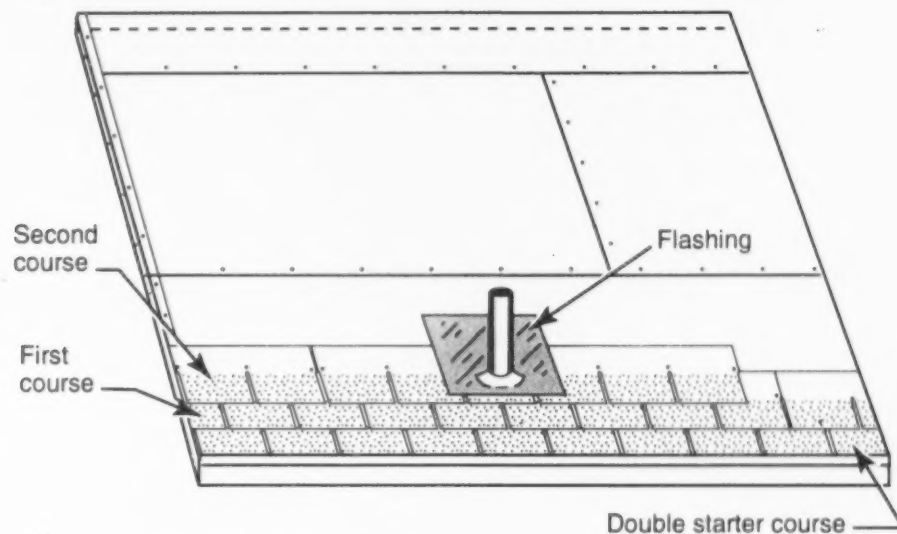
\_\_\_\_\_

c. Slide flashing over pipe so that it fits firmly, with top edge of flashing flange resting on underlayment and bottom edge of flashing flange resting over second course of shingles (Figure 8).

\_\_\_\_\_

Yes No

FIGURE 8



6. Finish second course of shingles. \_\_\_\_\_
7. Apply third course of shingles, following procedure determined for first course until you get to vent pipe. \_\_\_\_\_

**NOTE:** While you are fitting shingles around vent pipe, another person may continue applying shingles by stairstepping them up the roof's edge (Figure 9).

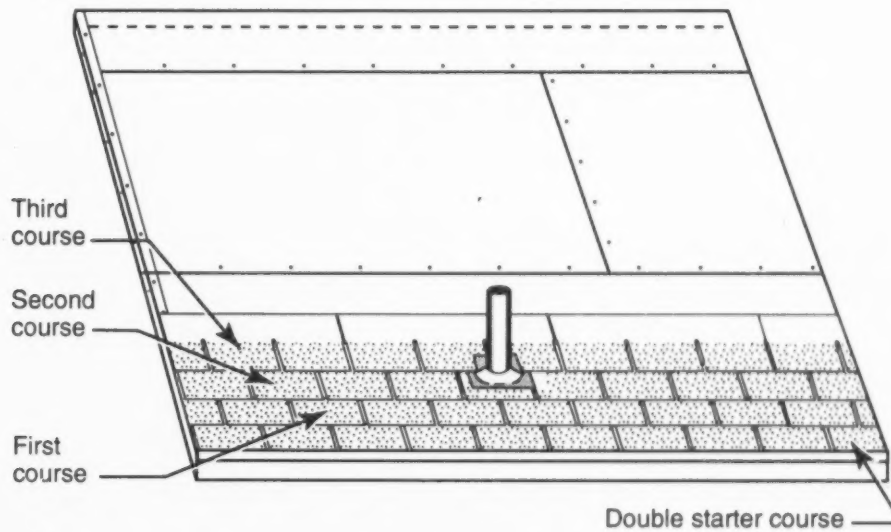
8. Make cutout for vent pipe by cutting and trimming shingle so that it fits around vent pipe and is in proper alignment with other shingles (Figure 9). \_\_\_\_\_

**NOTE:** When nailing the shingle around the vent pipe, do not nail within 6 inches of the vent pipe.



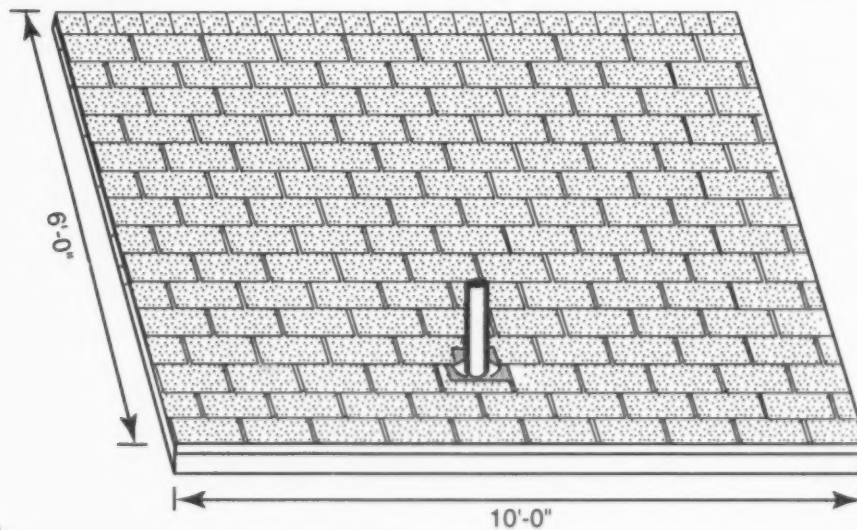
Yes No

FIGURE 9



9. Finish third course of shingles. \_\_\_\_\_
10. Continue applying courses, including ridge shingles, until project is completed. \_\_\_\_\_

FIGURE 10



Yes No

11. Have instructor check your project.

\_\_\_\_\_

12. Clean area and put away equipment and supplies.

\_\_\_\_\_

(End of Job Sheet)

### SKILL TEST RECORD

EVALUATOR'S  
COMMENTS

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PRODUCT  
EVALUATION

**Evaluator note:** Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

|                                                 |   |   |   |   |
|-------------------------------------------------|---|---|---|---|
| Proper use of equipment                         | 4 | 3 | 2 | 1 |
| Underlayment flush ( $\frac{1}{4}$ " )          | 4 | 3 | 2 | 1 |
| Nail spacing ( $18" \pm \frac{1}{4}"$ )         | 4 | 3 | 2 | 1 |
| First row even ( $\frac{1}{16}$ " of eave)      | 4 | 3 | 2 | 1 |
| Vent cutout clearance ( $\frac{1}{8}$ " )       | 4 | 3 | 2 | 1 |
| Course of shingles straight ( $\frac{1}{4}$ " ) | 4 | 3 | 2 | 1 |



EVALUATOR'S  
COMMENTS

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AVERAGE  
RATING

**Evaluator note:** To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE  
EVALUATION KEY

- 4 **Skilled** — Can perform job with no additional training
- 3 **Moderately Skilled** — Has performed job during training program; limited additional training may be required
- 2 **Limited Skill** — Has performed job during training program; additional training is required to develop skill
- 1 **Unskilled** — Is familiar with process, but is unable to perform job



**OBJECTIVE 7**

**Apply wood shingles with 5-inch exposure over spaced sheathing.**

**EQUIPMENT  
AND SUPPLIES**

- Safety goggles and hard hat
- Roofer's hatchet
- Utility knife
- Metal drip edge
- Wood shingles and manufacturer's instructions
- Roofing nails

**PROCEDURE**

**Yes No**



Research and  
Reference Skills

- Use standard references

Functional  
Reading Skills

- Follow written instructions
- Interpret graphics and symbols



Math Application Skills

- Use English and metric measures

1. Install metal drip edge.

a. Put on safety goggles and hard hat.

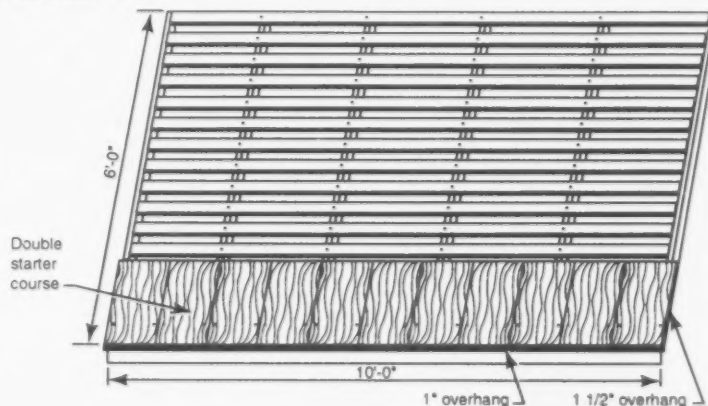
b. Put one nail about  $\frac{1}{2}$  inch in from center at each end of drip edge and another nail down about  $\frac{3}{4}$  inch from top edge.

c. Nail remainder of drip edge down, spacing nails about 10 inches apart down length of drip edge.

2. Apply starter course.

a. Apply first row of starter course, allowing 1-inch overhang at eave and leaving  $\frac{1}{4}$  to  $\frac{3}{8}$  inch between edges of shingles.

**FIGURE 11**





Job Acquisition/  
Development Skills

- Master specific job task/procedure

Yes No

- b. Nail each shingle, using two nails and spacing nails in from edge of shingle  $\frac{3}{4}$  inch and about  $1\frac{1}{2}$  inches about butt line of next course.

\_\_\_\_\_

**NOTE:** Drive nails flush with shingle surface. Do not damage surface of shingle around nail.

- c. Apply second row of starter course over first row, spacing shingles so that joints in second row are offset at least  $1\frac{1}{2}$  inches from joints in first row.

\_\_\_\_\_

3. Apply first course of shingles, allowing for 5-inch exposure and leaving  $\frac{1}{4}$  to  $\frac{3}{8}$  inch between edges of shingles.

\_\_\_\_\_

4. Continue applying courses, following procedure in step 3 until job is complete (Figures 12 and 13).

\_\_\_\_\_

FIGURE 12

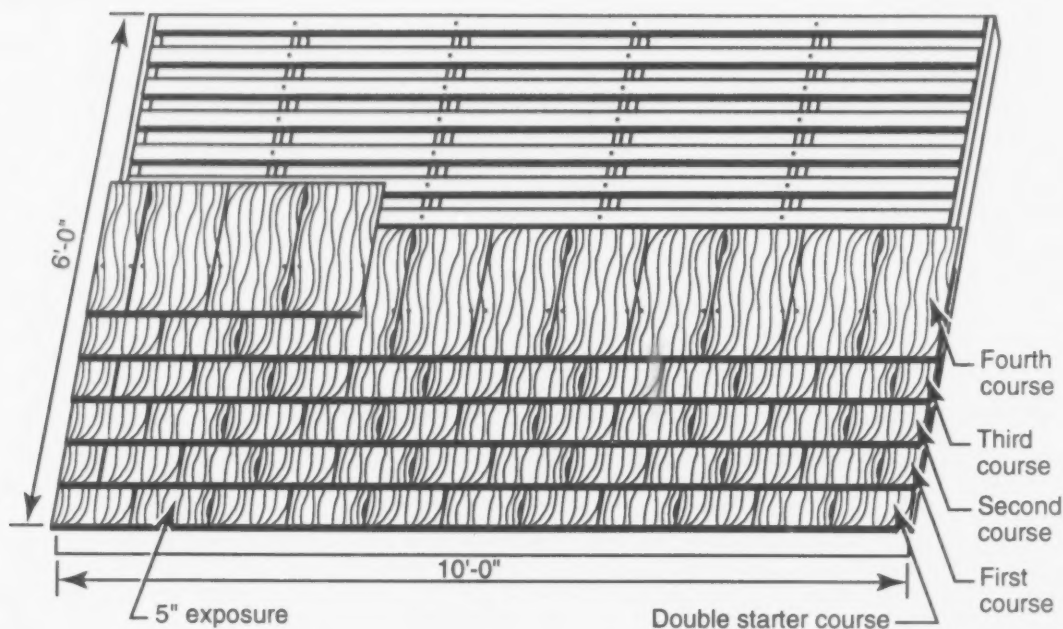
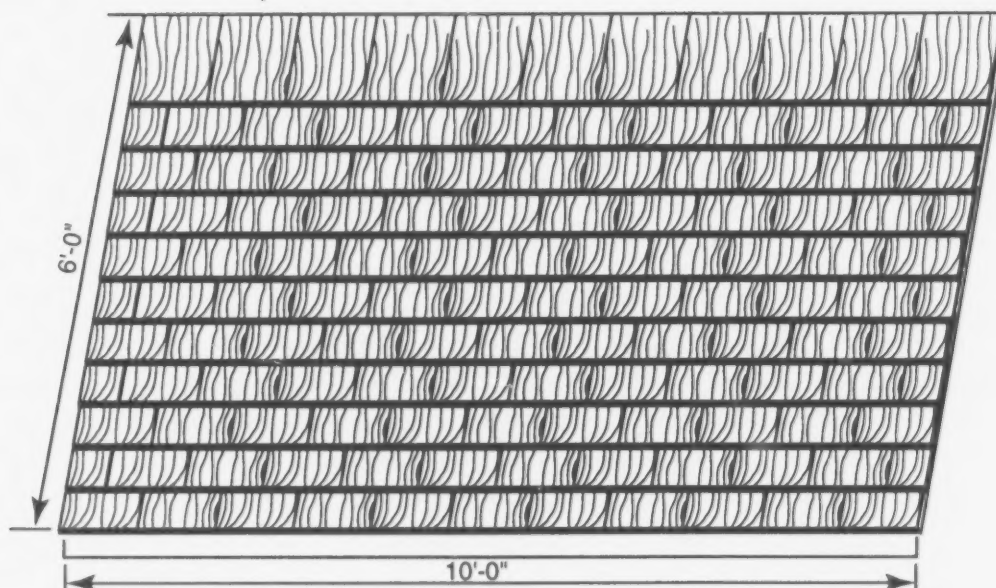




FIGURE 13

Yes No



5. Have instructor check your project. \_\_\_\_\_

6. Clean up area and put away equipment and supplies. \_\_\_\_\_

(End of Job Sheet)

### SKILL TEST RECORD

EVALUATOR'S  
COMMENTS

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**PRODUCT  
EVALUATION**

**Evaluator note:** Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

|                                                         |   |   |   |   |
|---------------------------------------------------------|---|---|---|---|
| Proper use of safety equipment                          | 4 | 3 | 2 | 1 |
| Nail spacing correct ( $\pm \frac{1}{4}$ " )            | 4 | 3 | 2 | 1 |
| Correct starter course overhang ( $\pm \frac{1}{8}$ " ) | 4 | 3 | 2 | 1 |
| Exposure proper ( $\pm \frac{1}{4}$ " )                 | 4 | 3 | 2 | 1 |
| Nails flush                                             | 4 | 3 | 2 | 1 |
| No damage to shingle surface                            | 4 | 3 | 2 | 1 |

**EVALUATOR'S  
COMMENTS**

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**AVERAGE  
RATING**

**Evaluator note:** To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

**PERFORMANCE  
EVALUATION KEY**

- 4 **Skilled** — Can perform job with no additional training
- 3 **Moderately Skilled** — Has performed job during training program; limited additional training may be required
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- 1 **Unskilled** — Is familiar with process, but is unable to perform job

180



| WRITTEN<br>TEST | APPLIED SKILLS <span style="float: right;">A 3</span> |
|-----------------|-------------------------------------------------------|
|-----------------|-------------------------------------------------------|

OBJECTIVE 1

Name \_\_\_\_\_ Score \_\_\_\_\_

**Given a list of terms associated with roofing skills, match them to their definitions. Write the letter that corresponds to the most correct answer.**

- \_\_\_\_\_ 1. A shingle that has adhesive pre-applied at the factory is supplied with a
  - a. bonding strip
  - b. roofing seal
  - c. self-sealing strip
  - d. surface mount
  
- \_\_\_\_\_ 2. A horizontal row of roof shingles is a
  - a. layer
  - b. built-up roof
  - c. break line
  - d. course
  
- \_\_\_\_\_ 3. The positioning of fasteners that will best secure roofing material is called the
  - a. nailing pattern
  - b. overlap method
  - c. staggering pattern
  - d. position nailing
  
- \_\_\_\_\_ 4. The staggering of the position of shingle tabs is called the
  - a. break
  - b. pattern overlap
  - c. flow pattern
  - d. both b and c are correct



- \_\_\_\_\_ 5. A projection of the roof on the upper side of a chimney to divert water is a
- a. cricket
  - b. saddle
  - c. exposure
  - d. both a and b are correct
- \_\_\_\_\_ 6. A roof made up of several layers of water resistant materials applied in an overlapping manner is
- a. in-course roofing
  - b. saddle roof
  - c. spaced sheathing roof
  - d. built-up roofing
- \_\_\_\_\_ 7. The initial or lowest course of shingles is known as the
- a. underlayment
  - b. starter course
  - c. decking
  - d. base course
- \_\_\_\_\_ 8. The visual portion of a shingle after installation is the
- a. edge or butt end
  - b. underlayment
  - c. exposure
  - d. post visual
- \_\_\_\_\_ 9. A metal sheet that is installed in a masonry joint and bent downward over a base flashing is a
- a. breaker
  - b. saddle flashing
  - c. counterflashing
  - d. course overlap



- \_\_\_\_\_ 10. Lumber used for roof decking and spaced to improve air flow below the shingles is
- a. plywood decking
  - b. overlapped sheathing
  - c. T&G lumber
  - d. spaced sheathing
- \_\_\_\_\_ 11. The maximum amount of weight that can be hoisted by lifting equipment is
- a. load lifting limit
  - b. volume limit
  - c. gross lift
  - d. bearing capacity
- \_\_\_\_\_ 12. The amount of weight that can safely be supported by the roof is
- a. volume limit
  - b. load bearing capacity
  - c. distribution capacity
  - d. weight/volume limit

**OBJECTIVE 2**

**State the safety rules pertaining to roofing.**

- \_\_\_\_\_ 1. When working on steep roofs, a roofer must use
- a. toeholds
  - b. fall protection equipment
  - c. goggles and a hard hat
  - d. all the above may be appropriate
- \_\_\_\_\_ 2. If a ladder extends 3 feet above the roof line, it must be
- a. secured at the bottom
  - b. made of a non-metallic material
  - c. equipped with non-skid plates on each rung
  - d. all the above



- \_\_\_\_\_ 3. All ladders must be equipped with
- a. non-metallic rungs
  - b. hooks
  - c. safety shoes
  - d. fall protection
- \_\_\_\_\_ 4. When working on a roof, you should wear appropriate dress to protect you from the elements and prevent
- a. frostbite
  - b. sunstrokes
  - c. sunburns
  - d. all the above
- \_\_\_\_\_ 5. When placing bundled shingles on a roof,
- a. distribute the load evenly over the entire roof area
  - b. stack them in the center of the roof
  - c. distribute the bundles along the roof edge
  - d. place only one bundle on roof
- \_\_\_\_\_ 6. When using a rolling scaffold, you must
- a. remove the wheels before ascending
  - b. wear fall protection
  - c. ensure the wheels are locked before ascending
  - d. never move the scaffold without disassembling it
- \_\_\_\_\_ 7. The right ladder to ascend a 16 foot high building is
- a. a 16 foot ladder
  - b. a 28 foot extension ladder
  - c. a 36 foot ladder
  - d. a 48 foot ladder
- \_\_\_\_\_ 8. When using AC powered tools or equipment, you should use a/an
- a. ungrounded AC circuit
  - b. GFCI circuit
  - c. two conductor extension cord
  - d. both a and c are correct



- \_\_\_\_\_ 9. You should never work on scaffold
- a. during storms or high winds
  - b. when scaffolds are covered with ice or snow
  - c. when scaffolds are wet
  - d. both a and b are correct
- \_\_\_\_\_ 10. Before using a power nailer or stapler, you must
- a. read manufacturer's instructions and pass a safety test
  - b. watch a co-worker use the tool
  - c. be familiar with all the operating instructions
  - d. wear ear and face protection
- \_\_\_\_\_ 11. A conveyor is being used to hoist shingles to a roof, you must
- a. ensure you stay within the load limits of the equipment
  - b. ensure no one walks under the load
  - c. observe all OSHA rules and regulations
  - d. all the above

**OBJECTIVE 3**

**Match minimum slope requirements to their specific roof applications.**

- \_\_\_\_\_ 1. A roof with a 1 in 12 slope requires
- a. roll roofing
  - b. roll roofing with exposed nails
  - c. any shingle style
  - d. built-up roofing
- \_\_\_\_\_ 2. A 5 in 12 roof slope requires
- a. use of any style of single roof
  - b. roll roofing only
  - c. roll roofing with exposed nails
  - d. built-up roofing only





- \_\_\_\_\_ 4. For a roof with a 3 in 12 slope, use
- a. built-up roofing
  - b. shingle roofing
  - c. roll roofing with exposed nails
  - d. double-coverage roll roofing

**OBJECTIVE 4**

**Given alternatives, choose the proper roof areas where flashing should be used.**

- \_\_\_\_\_ 1. Flashing should be used
- a. around chimneys
  - b. on all flat surfaces of the roof
  - c. under each shingle exposure
  - d. over all roof decking
- \_\_\_\_\_ 2. Flashing must be used
- a. below all underlayment
  - b. over seams/joints of plywood
  - c. below the starter course
  - d. around vent stacks

**OBJECTIVE 5**

**State guidelines for applying decking, underlayment, shingles, and flashing.**

- \_\_\_\_\_ 1. Before applying plywood decking, you should be certain it is
- a. interior grade
  - b. at least  $\frac{1}{2}$ " thick and exterior grade
  - c. less than  $\frac{1}{2}$ " thick
  - d. not T&G or standard edged plywood
- \_\_\_\_\_ 2. The roof decking material and type of fasteners are specified
- a. by building plans to meet or exceed local building codes
  - b. by federal agencies funding the building project
  - c. by the contractor or builder
  - d. jointly by the carpenter and roofer



- \_\_\_\_\_ 3. When applying plywood decking,
- a. the first row must be fastened near the ridge of the roof
  - b. all plywood joints must be aligned vertically
  - c. the plywood should be cut prior to fastening to the rafters
  - d. the first sheets must be fastened to the lowest or bottom row
- \_\_\_\_\_ 4. Plywood decking should be fastened to extend above the ridge and over the gable ends and then
- a. marked only
  - b. cut with a table saw before fastening
  - c. marked and cut with a circular saw
  - d. left extended until underlayment is placed
- \_\_\_\_\_ 5. Underlayment must be lapped at least \_\_\_\_\_" at the top.
- a. 5
  - b. 4
  - c. 3
  - d. 2
- \_\_\_\_\_ 6. When applying wood shingles, the roofer must
- a. be certain joints in alternate courses are not in direct alignment
  - b. use three to five nails in each shingle depending on their width
  - c. always extend the shingle 2" beyond the finished fascia board
  - d. attach hip and ridge shingles with same overlap
- \_\_\_\_\_ 7. When applying asphalt shingles, you must first
- a. use all appropriate personal protection equipment
  - b. fasten the double starter course
  - c. attach hip and ridge with shingles
  - d. apply drip edge along the eaves and gable ends

\_\_\_\_\_ 8. Asphalt shingles should be fastened with \_\_\_\_\_ roofing nails.

- a. 1
- b. 2
- c. 3
- d. 4

\_\_\_\_\_ 9. The first course of asphalt shingles should begin with

- a. a full shingle minus one half tab
- b. a full shingle
- c. half a full shingle
- d. one fourth a full shingle

\_\_\_\_\_ 10. The final step in applying either a wood or asphalt roof is to

- a. install flashing
- b. double the starter course
- c. attach hip and ridge shingles
- d. install underlayment



| WRITTEN TEST<br>ANSWERS | APPLIED SKILLS <span style="float: right;">A 3</span> |                                                 |
|-------------------------|-------------------------------------------------------|-------------------------------------------------|
| OBJECTIVE 1             | 1. c<br>2. d<br>3. a<br>4. a<br>5. d<br>6. d          | 7. b<br>8. c<br>9. c<br>10. d<br>11. a<br>12. b |
| OBJECTIVE 2             | 1. d<br>2. a<br>3. c<br>4. d<br>5. a<br>6. c          | 7. b<br>8. b<br>9. d<br>10. a<br>11. d          |
| OBJECTIVE 3             | 1. d<br>2. a<br>3. c                                  |                                                 |
| OBJECTIVE 4             | 1. a<br>2. d                                          |                                                 |



**OBJECTIVE 5**

- |      |       |
|------|-------|
| 1. b | 6. a  |
| 2. a | 7. a  |
| 3. d | 8. d  |
| 4. c | 9. b  |
| 5. d | 10. c |

150



# CIMC TEST CODE SHEET

VOCATIONAL PROGRAM (BOOK TITLE) *Introduction to Roofing*

UNIT NUMBER AND TITLE — A 3 Applied Skills

**TOTAL NUMBER OF TEST QUESTIONS 40**

**TOTAL NUMBER OF BASIC SKILL QUESTIONS** 0

[illegible]

## INTRODUCTION TO ROOFING COMPETENCY PROFILE

Student \_\_\_\_\_ Soc. Sec. No. \_\_\_\_\_  
                     Last                                      First                                      MI

|                                    |                        |              |
|------------------------------------|------------------------|--------------|
| PROGRAM _____                      | Grade 9 10 11 12 Adult | SCHOOL _____ |
| INSTRUCTOR _____                   | SCHOOL ADDRESS _____   | PHONE _____  |
| STUDENT'S HOME ADDRESS _____       | DATE OF BIRTH _____    | PHONE _____  |
| STUDENT'S EMPLOYER _____           | ADDRESS _____          | PHONE _____  |
| CONTACT IN CASE OF EMERGENCY _____ |                        | PHONE _____  |
| ADDRESS _____                      |                        |              |
| OR _____                           |                        |              |
| ADDRESS _____                      |                        | PHONE _____  |

The above information can be used for school records and/or to ensure safety of students. This confidential information is not to be released to employers or to the general public.

### ON-THE-JOB TRAINING/WORK EXPERIENCE

| DURATION OF<br>EMPLOYMENT | JOB TITLE | EMPLOYER | SUPERVISOR'S<br>NAME | ADDRESS OF EMPLOYER | PHONE |
|---------------------------|-----------|----------|----------------------|---------------------|-------|
|                           |           |          |                      |                     |       |
|                           |           |          |                      |                     |       |
|                           |           |          |                      |                     |       |

This agency does not discriminate on the basis of race, creed, color, national origin, sex, age, veteran status, qualified handicap, or disability.





## SPECIFIC JOB COMPETENCIES

**DIRECTIONS:** Evaluate the trainee using the rating scale below, and check the appropriate number to indicate the degree of competency. The numerical ratings of 4, 3, 2, 1, and 0 are not intended to represent the traditional school grading system of A, B, C, D, and F. The descriptions associated with each of the numbers focus on level of student performance for each of the tasks listed below.

**Rating Scale:** 4 — **Skilled** — can perform job independently with no additional training.

3 — **Moderately Skilled** — has performed job independently during the training program; limited additional training may be required.

2 — **Limited Practice** — has practiced job during training program; additional training is required to develop skill.

1 — **Exposure Only** — general information provided with no practice time; close supervision needed and additional training required.

0 — **No Exposure** — no information or practice provided during training program; complete training required.

### UNIT A1

|   |   |   |   |   |
|---|---|---|---|---|
| 4 | 3 | 2 | 1 | 0 |
|   |   |   |   |   |
|   |   |   |   |   |

#### Roofing Materials

1. Given a list of terms associated with roofing materials, match them to their correct definitions.
2. Given drawings, identify common roof designs.
3. Identify the parts of a roof.
4. Given drawings, identify basic types of shingles, underlayment, drip strips, caps, louvers, and vents.
5. Provided drawings, match roofing fasteners to their names.
6. Identify materials used on commercial buildings that utilize built-up roofing methods.
7. Name the purpose and material types used for flashing.
8. Estimate the material required to install a three-tab asphalt-shingle roof.

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WRITTEN TEST SCORE \_\_\_\_\_

### UNIT A2

|   |   |   |   |   |
|---|---|---|---|---|
| 4 | 3 | 2 | 1 | 0 |
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#### Roof Tools and Equipment

1. Given a list of terms associated with roofing tools, match them to their correct definitions.
2. From alternatives, choose the proper care and safety guidelines for the use of hand and power tools.
3. Given drawings, identify safety equipment and hand tools used for the installation of roofs.
4. Given drawings, identify power tools and equipment used for the installation of roofs.
5. Use a roofer's hatchet properly.
6. Use a pneumatic fastener.

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WRITTEN TEST SCORE \_\_\_\_\_

### UNIT A3

|   |   |   |   |   |
|---|---|---|---|---|
| 4 | 3 | 2 | 1 | 0 |
|   |   |   |   |   |
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#### Applied Skills

1. Given a list of terms associated with roofing skills, match them to their definitions.
2. State the safety rules pertaining to roofing.
3. Match minimum slope requirements to their specific roof applications.
4. Given alterations, choose the proper roof areas where flashing should be used.
5. State guidelines for applying decking, underlayment, shingles, and flashing.
6. Apply asphalt shingles with a 5-inch exposure.
7. Apply wood shingles with a 5-inch exposure over spaced sheathing.

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WRITTEN TEST SCORE \_\_\_\_\_

### Use of This Document

Use of this document can be used to record information about the student and the skills mastered by the student. This information is useful in documenting student progress during the training program and to provide information about the student's qualifications to potential employers and for entry into advanced training programs. Instructors using AGC-CIMC instructional materials are authorized to reproduce this document as required for use in their training programs.

# INTRODUCTION TO ROOFING

CIMC



## READING SKILLS



Reading  
Comprehension

Research and  
Reference

Functional  
Reading

Language

Composition



### UNITS OF INSTRUCTION

| Gain factual information | Distinguish fact, opinion and inference | Recognize stereotyping and bias | Recognize propaganda | Analyze cause and effect | Draw conclusions | Make generalizations | React to written material | Apply word analysis techniques | Select useful resources | Locate resources | Find materials in library | Use standard references | Use in-book reference tools | Use audiovisual media | Use computer data base | Use magazines and newspapers | Interpret forms and records | Follow written instructions | Interpret graphics and symbols | Use content area vocabulary | Interpret abbreviations/acronyms | Read aloud | Use standard grammar and correct spelling, punctuation, and capitalization | State ideas clearly | Use complete sentences | Develop preliminary outline | Use topic sentences | Use introductory/closing paragraphs | Compose reports | Compose essays | Proofread and edit |
|--------------------------|-----------------------------------------|---------------------------------|----------------------|--------------------------|------------------|----------------------|---------------------------|--------------------------------|-------------------------|------------------|---------------------------|-------------------------|-----------------------------|-----------------------|------------------------|------------------------------|-----------------------------|-----------------------------|--------------------------------|-----------------------------|----------------------------------|------------|----------------------------------------------------------------------------|---------------------|------------------------|-----------------------------|---------------------|-------------------------------------|-----------------|----------------|--------------------|
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Roofing Materials

Roofing Tools

Applied Skills

# CIMC BASIC SKILLS DOCUMENTATION

## WRITING SKILLS



## MATH SKILLS

| Research                            | Functional Writing | Operation and Calculation | Math Application | Data Analysis and Display |
|-------------------------------------|--------------------|---------------------------|------------------|---------------------------|
| Construct graphics and symbols      |                    |                           |                  |                           |
| Take notes                          |                    |                           |                  |                           |
| Use notecards                       |                    |                           |                  |                           |
| Create bibliography                 |                    |                           |                  |                           |
| Use footnotes                       |                    |                           |                  |                           |
| Outline material                    |                    |                           |                  |                           |
| Complete forms and records          |                    |                           |                  |                           |
| Write instructions                  |                    |                           |                  |                           |
| Write letters                       |                    |                           |                  |                           |
| Write job applications              |                    |                           |                  |                           |
| Write resumes                       |                    |                           |                  |                           |
| Use word processing                 |                    |                           |                  |                           |
| Use computer graphics               |                    |                           |                  |                           |
| Round off numbers                   |                    |                           |                  |                           |
| Estimate answers                    |                    |                           |                  |                           |
| Use scientific notations            |                    |                           |                  |                           |
| Use exponential notations           |                    |                           |                  |                           |
| Calculate with whole numbers        |                    |                           |                  |                           |
| Calculate with fractions            |                    |                           |                  |                           |
| Calculate with decimals             |                    |                           |                  |                           |
| Convert whole numbers to fractions  |                    |                           |                  |                           |
| Convert whole numbers to decimals   |                    |                           |                  |                           |
| Solve numerical expressions         |                    |                           |                  |                           |
| Solve formulae and equations        |                    |                           |                  |                           |
| Obtain squares and square roots     |                    |                           |                  |                           |
| Convert units of measure            |                    |                           |                  |                           |
| Perform metric calculations         |                    |                           |                  |                           |
| Solve word problems                 |                    |                           |                  |                           |
| Select/apply mathematical formula   |                    |                           |                  |                           |
| Select/apply mathematical procedure |                    |                           |                  |                           |
| Use English and metric measures     |                    |                           |                  |                           |
| Solve time/rate/distance problems   |                    |                           |                  |                           |
| Solve ratio/proportion problems     |                    |                           |                  |                           |
| Solve percent problems              |                    |                           |                  |                           |
| Apply techniques of scaling         |                    |                           |                  |                           |
| Apply algebra principles            |                    |                           |                  |                           |
| Apply geometry principles           |                    |                           |                  |                           |
| Apply trigonometry principles       |                    |                           |                  |                           |
| Interpret charts and tables         |                    |                           |                  |                           |
| Interpret graphs (type)             |                    |                           |                  |                           |
| Collect /record data                |                    |                           |                  |                           |
| Apply sampling techniques           |                    |                           |                  |                           |
| Apply principles of probability     |                    |                           |                  |                           |
| Construct charts and tables         |                    |                           |                  |                           |
| Construct graphs                    |                    |                           |                  |                           |
| Calculate statistics                |                    |                           |                  |                           |



| Skills by                      | Functional Math | General Science                           | Life Science                                       | Physical Science                      | Earth Science                                         |
|--------------------------------|-----------------|-------------------------------------------|----------------------------------------------------|---------------------------------------|-------------------------------------------------------|
| Construct graphs               |                 | Apply computing skills                    | Identify/classify living organisms                 | Analyze/classify matter               | Investigate physical characteristics of the earth     |
| Calculate statistics           |                 | Apply scientific method of inquiry        | Investigate biological history of the earth        | Investigate forms/changes of matter   | Investigate geological history of the earth           |
| Interpret statistics           |                 | Conduct experiments                       | Investigate food chains, webs, pyramids            | Investigate forms/changes of energy   | Investigate physical forces acting on the earth       |
| Interpret blueprints/plans     |                 | Investigate science ethics                | Investigate/apply principles of human development  | Investigate/apply chemical properties | Solve problems of longitude, latitude, and time zones |
| Make measurements              |                 | Investigate science history               | Investigate/apply principles of genetics/heredity  | Investigate/apply physical laws       | Investigate conservation of physical resources        |
| Perform banking transactions   |                 | Investigate/apply economics in technology | Investigate/apply principles of anatomy/physiology |                                       | Investigate conservation of living resources          |
| Make change                    |                 | Use scientific instruments                | Investigate health issues                          |                                       | Investigate issues of environmental impact            |
| Solve practical problems       |                 | Investigate/apply technology              |                                                    |                                       | Apply science principles to environmental issues      |
| Calculate gross earnings       |                 | Collect specimens                         |                                                    |                                       |                                                       |
| Solve income/expense problems  |                 |                                           |                                                    |                                       |                                                       |
| Prepare a budget               |                 |                                           |                                                    |                                       |                                                       |
| Calculate interest             |                 |                                           |                                                    |                                       |                                                       |
| Solve interest problems        |                 |                                           |                                                    |                                       |                                                       |
| Calculate sales tax            |                 |                                           |                                                    |                                       |                                                       |
| Determine income tax           |                 |                                           |                                                    |                                       |                                                       |
| Use calculator for computation |                 |                                           |                                                    |                                       |                                                       |
| Use computer for computation   |                 |                                           |                                                    |                                       |                                                       |
| Use computer spreadsheets      |                 |                                           |                                                    |                                       |                                                       |





**INTERPE**



| Oral<br>Presentation                                          | Listening | Interactive<br>Communication | General<br>Relating |
|---------------------------------------------------------------|-----------|------------------------------|---------------------|
| Make informative presentations                                |           |                              |                     |
| Make persuasive presentations                                 |           |                              |                     |
| Present personal opinion/viewpoint                            |           |                              |                     |
| Use good speaking techniques                                  |           |                              |                     |
| Select/use words effectively                                  |           |                              |                     |
| Use effective body language                                   |           |                              |                     |
| Present appropriate appearance                                |           |                              |                     |
| Integrate audio and/or visual materials in oral presentations |           |                              |                     |
| Adapt presentation to specific audience                       |           |                              |                     |
| Apply active listening skills                                 |           |                              |                     |
| Distinguish fact, opinion, and inference                      |           |                              |                     |
| Draw conclusions/make generalizations                         |           |                              |                     |
| Analyze/identify point of view                                |           |                              |                     |
| Give/follow oral directions                                   |           |                              |                     |
| Apply questioning techniques                                  |           |                              |                     |
| Conduct/receive interviews                                    |           |                              |                     |
| Analyze/apply nonverbal communication                         |           |                              |                     |
| Work effectively in a group                                   |           |                              |                     |
| Communicate with clients/customers/patients                   |           |                              |                     |
| Communicate with co-workers                                   |           |                              |                     |
| Communicate with supervisors                                  |           |                              |                     |
| Communicate with professional colleagues/associates           |           |                              |                     |
| Apply telephone etiquette                                     |           |                              |                     |
| Investigate/apply communication process models                |           |                              |                     |
| Analyze/apply nonverbal communication                         |           |                              |                     |
| Investigate/apply cross-cultural communication                |           |                              |                     |
| Interact with co-workers                                      |           |                              |                     |
| Interact with supervisors                                     |           |                              |                     |
| Interact with clients/customers/patients                      |           |                              |                     |
| Interact with professional colleagues/associates              |           |                              |                     |
| Participate in group activities                               |           |                              |                     |
| Participate in industrial relations/functions                 |           |                              |                     |
| Identify personal values/attitudes                            |           |                              |                     |
| Apply information to life experiences                         |           |                              |                     |
| Identify values/attitudes                                     |           |                              |                     |
| Identify needs/drives                                         |           |                              |                     |
| Select/apply appropriate behavior                             |           |                              |                     |

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# INTERPERSONAL OR RELATING SKILLS



# CREATIVE THINKING/ PROBLEM SOLVING SKILLS



EMPL

| Teamwork<br>Cooperation                                         | Leadership<br>Influence | Cognitive Activities | Job Skills<br>Subsection |
|-----------------------------------------------------------------|-------------------------|----------------------|--------------------------|
| Apply information to life experiences                           |                         |                      |                          |
| Identify values/attitudes                                       |                         |                      |                          |
| Identify needs/drives                                           |                         |                      |                          |
| Select/apply appropriate behavior                               |                         |                      |                          |
| Investigate/identify personal styles                            |                         |                      |                          |
| Investigate/identify group/corporate climate                    |                         |                      |                          |
| Give/receive feedback                                           |                         |                      |                          |
| Identify hidden purposes                                        |                         |                      |                          |
| Investigate/apply group dynamics                                |                         |                      |                          |
| Control undesirable/inappropriate behavior                      |                         |                      |                          |
| Resolve conflicts                                               |                         |                      |                          |
| Clarify goals/objectives                                        |                         |                      |                          |
| Devise "win/win" situations                                     |                         |                      |                          |
| Build consensus                                                 |                         |                      |                          |
| Generate ideas                                                  |                         |                      |                          |
| Present point of view                                           |                         |                      |                          |
| Analyze/apply leadership styles                                 |                         |                      |                          |
| Analyze/apply management styles                                 |                         |                      |                          |
| Obtain confidence of others                                     |                         |                      |                          |
| Develop esteem in self/others                                   |                         |                      |                          |
| Persuade others                                                 |                         |                      |                          |
| Analyze/apply motivation techniques                             |                         |                      |                          |
| Provide positive coaching                                       |                         |                      |                          |
| Collect/record information                                      |                         |                      |                          |
| Identify critical elements/issues                               |                         |                      |                          |
| Define a problem                                                |                         |                      |                          |
| Identify underlying causes                                      |                         |                      |                          |
| Apply a problem-solving model                                   |                         |                      |                          |
| Analyze/synthesize information                                  |                         |                      |                          |
| Identify/analyze underlying assumptions                         |                         |                      |                          |
| Draw conclusions                                                |                         |                      |                          |
| Predict results/outcomes                                        |                         |                      |                          |
| Identify/evaluate consequences                                  |                         |                      |                          |
| Identify/develop alternatives                                   |                         |                      |                          |
| Evaluate alternatives                                           |                         |                      |                          |
| Select an alternative                                           |                         |                      |                          |
| Devise a solution                                               |                         |                      |                          |
| Create a finished product                                       |                         |                      |                          |
| Apply intuitive/creative thinking processes                     |                         |                      |                          |
| Transfer knowledge/training to new situations                   |                         |                      |                          |
| Apply new technology                                            |                         |                      |                          |
| Develop an action plan                                          |                         |                      |                          |
| Evaluate results/outcomes                                       |                         |                      |                          |
| Analyze personal occupational aptitudes/preferences             |                         |                      |                          |
| Investigate employment prospects of a career field/occupation   |                         |                      |                          |
| Investigate training requirements for a career field/occupation |                         |                      |                          |
| Investigate benefits of a career field/occupation               |                         |                      |                          |
| Compare/evaluate career options                                 |                         |                      |                          |
| Develop personal career path                                    |                         |                      |                          |
| Locate appropriate jobs                                         |                         |                      |                          |

# EMPLOYABILITY SKILLS

# SOCIAL STUDIES SKILLS



| Job Acquisition Development                              |  |  |  |  |  |  |  |  |  | Information Analysis                      |  |  |  |  |  |  |  |  |  | Social Studies Application                          |  |  |  |  |  |  |  |  |                                                     | Functional Social Studies |  |  |  |  |  |  |  |  |  |
|----------------------------------------------------------|--|--|--|--|--|--|--|--|--|-------------------------------------------|--|--|--|--|--|--|--|--|--|-----------------------------------------------------|--|--|--|--|--|--|--|--|-----------------------------------------------------|---------------------------|--|--|--|--|--|--|--|--|--|
| Develop personal career path                             |  |  |  |  |  |  |  |  |  | Collect/record data                       |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. history                      |  |  |  |  |  |  |  |  | Practice responsible personal economics             |                           |  |  |  |  |  |  |  |  |  |
| Locate appropriate jobs                                  |  |  |  |  |  |  |  |  |  | Interpret graphical information           |  |  |  |  |  |  |  |  |  | Investigate/apply world history                     |  |  |  |  |  |  |  |  | Prepare a personal budget                           |                           |  |  |  |  |  |  |  |  |  |
| Analyze duties/requirements/benefits of specific job     |  |  |  |  |  |  |  |  |  | Construct graphical information           |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. geography                    |  |  |  |  |  |  |  |  | Use credit responsibly                              |                           |  |  |  |  |  |  |  |  |  |
| Master specific job task/procedure                       |  |  |  |  |  |  |  |  |  | Interpret maps/globes                     |  |  |  |  |  |  |  |  |  | Investigate/apply principles of government/politics |  |  |  |  |  |  |  |  | Practice good work ethics                           |                           |  |  |  |  |  |  |  |  |  |
| Fill in job-related applications                         |  |  |  |  |  |  |  |  |  | Interpret statistical information         |  |  |  |  |  |  |  |  |  | Investigate/apply principles of economics           |  |  |  |  |  |  |  |  | Participate in industrial relations                 |                           |  |  |  |  |  |  |  |  |  |
| Write letter of application                              |  |  |  |  |  |  |  |  |  | Analyze/interpret demographic information |  |  |  |  |  |  |  |  |  | Investigate/apply principles of ethics              |  |  |  |  |  |  |  |  | Interact with people of different races/cultures    |                           |  |  |  |  |  |  |  |  |  |
| Write personal resume                                    |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. history            |  |  |  |  |  |  |  |  |  | Investigate/apply principles of psychology          |  |  |  |  |  |  |  |  | Investigate/participate in government               |                           |  |  |  |  |  |  |  |  |  |
| Interview for a job                                      |  |  |  |  |  |  |  |  |  | Investigate/apply world history           |  |  |  |  |  |  |  |  |  | Investigate/apply principles of sociology           |  |  |  |  |  |  |  |  | Select/use sources of information on current events |                           |  |  |  |  |  |  |  |  |  |
| Apply business etiquette                                 |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. geography          |  |  |  |  |  |  |  |  |  | Investigate/apply cross-cultural studies            |  |  |  |  |  |  |  |  | Practice responsible personal economics             |                           |  |  |  |  |  |  |  |  |  |
| Practice good work habits/attitudes                      |  |  |  |  |  |  |  |  |  | Interpret graphical information           |  |  |  |  |  |  |  |  |  | Practice good work ethics                           |  |  |  |  |  |  |  |  | Prepare a personal budget                           |                           |  |  |  |  |  |  |  |  |  |
| Develop good personal presentation                       |  |  |  |  |  |  |  |  |  | Construct graphical information           |  |  |  |  |  |  |  |  |  | Use credit responsibly                              |  |  |  |  |  |  |  |  | Practice good work ethics                           |                           |  |  |  |  |  |  |  |  |  |
| Develop self-confidence/esteem                           |  |  |  |  |  |  |  |  |  | Interpret maps/globes                     |  |  |  |  |  |  |  |  |  | Participate in industrial relations                 |  |  |  |  |  |  |  |  | Interact with people of different races/cultures    |                           |  |  |  |  |  |  |  |  |  |
| Develop effective leadership                             |  |  |  |  |  |  |  |  |  | Interpret statistical information         |  |  |  |  |  |  |  |  |  | Investigate/participate in government               |  |  |  |  |  |  |  |  | Investigate/apply American legal practices          |                           |  |  |  |  |  |  |  |  |  |
| Deal effectively with supervisors                        |  |  |  |  |  |  |  |  |  | Analyze/interpret demographic information |  |  |  |  |  |  |  |  |  | Investigate/apply principles of sociology           |  |  |  |  |  |  |  |  | Select/use sources of information on current events |                           |  |  |  |  |  |  |  |  |  |
| Deal effectively with co-workers                         |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. history            |  |  |  |  |  |  |  |  |  | Investigate/apply cross-cultural studies            |  |  |  |  |  |  |  |  | Practice responsible personal economics             |                           |  |  |  |  |  |  |  |  |  |
| Deal effectively with professional colleagues/associates |  |  |  |  |  |  |  |  |  | Investigate/apply world history           |  |  |  |  |  |  |  |  |  | Practice good work ethics                           |  |  |  |  |  |  |  |  | Prepare a personal budget                           |                           |  |  |  |  |  |  |  |  |  |
| Deal effectively with customers/clients                  |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. geography          |  |  |  |  |  |  |  |  |  | Use credit responsibly                              |  |  |  |  |  |  |  |  | Practice good work ethics                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Interpret graphical information           |  |  |  |  |  |  |  |  |  | Participate in industrial relations                 |  |  |  |  |  |  |  |  | Interact with people of different races/cultures    |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Construct graphical information           |  |  |  |  |  |  |  |  |  | Investigate/participate in government               |  |  |  |  |  |  |  |  | Investigate/apply American legal practices          |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Interpret maps/globes                     |  |  |  |  |  |  |  |  |  | Investigate/apply principles of sociology           |  |  |  |  |  |  |  |  | Select/use sources of information on current events |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Analyze/interpret demographic information |  |  |  |  |  |  |  |  |  | Investigate/apply cross-cultural studies            |  |  |  |  |  |  |  |  | Practice responsible personal economics             |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. history            |  |  |  |  |  |  |  |  |  | Practice good work ethics                           |  |  |  |  |  |  |  |  | Prepare a personal budget                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply world history           |  |  |  |  |  |  |  |  |  | Use credit responsibly                              |  |  |  |  |  |  |  |  | Practice good work ethics                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. geography          |  |  |  |  |  |  |  |  |  | Participate in industrial relations                 |  |  |  |  |  |  |  |  | Interact with people of different races/cultures    |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Interpret graphical information           |  |  |  |  |  |  |  |  |  | Investigate/participate in government               |  |  |  |  |  |  |  |  | Investigate/apply American legal practices          |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Construct graphical information           |  |  |  |  |  |  |  |  |  | Investigate/apply principles of sociology           |  |  |  |  |  |  |  |  | Select/use sources of information on current events |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Analyze/interpret demographic information |  |  |  |  |  |  |  |  |  | Investigate/apply cross-cultural studies            |  |  |  |  |  |  |  |  | Practice responsible personal economics             |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. history            |  |  |  |  |  |  |  |  |  | Practice good work ethics                           |  |  |  |  |  |  |  |  | Prepare a personal budget                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply world history           |  |  |  |  |  |  |  |  |  | Use credit responsibly                              |  |  |  |  |  |  |  |  | Practice good work ethics                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. geography          |  |  |  |  |  |  |  |  |  | Participate in industrial relations                 |  |  |  |  |  |  |  |  | Interact with people of different races/cultures    |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Interpret graphical information           |  |  |  |  |  |  |  |  |  | Investigate/participate in government               |  |  |  |  |  |  |  |  | Investigate/apply American legal practices          |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Construct graphical information           |  |  |  |  |  |  |  |  |  | Investigate/apply principles of sociology           |  |  |  |  |  |  |  |  | Select/use sources of information on current events |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Analyze/interpret demographic information |  |  |  |  |  |  |  |  |  | Investigate/apply cross-cultural studies            |  |  |  |  |  |  |  |  | Practice responsible personal economics             |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. history            |  |  |  |  |  |  |  |  |  | Practice good work ethics                           |  |  |  |  |  |  |  |  | Prepare a personal budget                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply world history           |  |  |  |  |  |  |  |  |  | Use credit responsibly                              |  |  |  |  |  |  |  |  | Practice good work ethics                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. geography          |  |  |  |  |  |  |  |  |  | Participate in industrial relations                 |  |  |  |  |  |  |  |  | Interact with people of different races/cultures    |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Interpret graphical information           |  |  |  |  |  |  |  |  |  | Investigate/participate in government               |  |  |  |  |  |  |  |  | Investigate/apply American legal practices          |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Construct graphical information           |  |  |  |  |  |  |  |  |  | Investigate/apply principles of sociology           |  |  |  |  |  |  |  |  | Select/use sources of information on current events |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Analyze/interpret demographic information |  |  |  |  |  |  |  |  |  | Investigate/apply cross-cultural studies            |  |  |  |  |  |  |  |  | Practice responsible personal economics             |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. history            |  |  |  |  |  |  |  |  |  | Practice good work ethics                           |  |  |  |  |  |  |  |  | Prepare a personal budget                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply world history           |  |  |  |  |  |  |  |  |  | Use credit responsibly                              |  |  |  |  |  |  |  |  | Practice good work ethics                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. geography          |  |  |  |  |  |  |  |  |  | Participate in industrial relations                 |  |  |  |  |  |  |  |  | Interact with people of different races/cultures    |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Interpret graphical information           |  |  |  |  |  |  |  |  |  | Investigate/participate in government               |  |  |  |  |  |  |  |  | Investigate/apply American legal practices          |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Construct graphical information           |  |  |  |  |  |  |  |  |  | Investigate/apply principles of sociology           |  |  |  |  |  |  |  |  | Select/use sources of information on current events |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Analyze/interpret demographic information |  |  |  |  |  |  |  |  |  | Investigate/apply cross-cultural studies            |  |  |  |  |  |  |  |  | Practice responsible personal economics             |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. history            |  |  |  |  |  |  |  |  |  | Practice good work ethics                           |  |  |  |  |  |  |  |  | Prepare a personal budget                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply world history           |  |  |  |  |  |  |  |  |  | Use credit responsibly                              |  |  |  |  |  |  |  |  | Practice good work ethics                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. geography          |  |  |  |  |  |  |  |  |  | Participate in industrial relations                 |  |  |  |  |  |  |  |  | Interact with people of different races/cultures    |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Interpret graphical information           |  |  |  |  |  |  |  |  |  | Investigate/participate in government               |  |  |  |  |  |  |  |  | Investigate/apply American legal practices          |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Construct graphical information           |  |  |  |  |  |  |  |  |  | Investigate/apply principles of sociology           |  |  |  |  |  |  |  |  | Select/use sources of information on current events |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Analyze/interpret demographic information |  |  |  |  |  |  |  |  |  | Investigate/apply cross-cultural studies            |  |  |  |  |  |  |  |  | Practice responsible personal economics             |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. history            |  |  |  |  |  |  |  |  |  | Practice good work ethics                           |  |  |  |  |  |  |  |  | Prepare a personal budget                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply world history           |  |  |  |  |  |  |  |  |  | Use credit responsibly                              |  |  |  |  |  |  |  |  | Practice good work ethics                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. geography          |  |  |  |  |  |  |  |  |  | Participate in industrial relations                 |  |  |  |  |  |  |  |  | Interact with people of different races/cultures    |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Interpret graphical information           |  |  |  |  |  |  |  |  |  | Investigate/participate in government               |  |  |  |  |  |  |  |  | Investigate/apply American legal practices          |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Construct graphical information           |  |  |  |  |  |  |  |  |  | Investigate/apply principles of sociology           |  |  |  |  |  |  |  |  | Select/use sources of information on current events |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Analyze/interpret demographic information |  |  |  |  |  |  |  |  |  | Investigate/apply cross-cultural studies            |  |  |  |  |  |  |  |  | Practice responsible personal economics             |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. history            |  |  |  |  |  |  |  |  |  | Practice good work ethics                           |  |  |  |  |  |  |  |  | Prepare a personal budget                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply world history           |  |  |  |  |  |  |  |  |  | Use credit responsibly                              |  |  |  |  |  |  |  |  | Practice good work ethics                           |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  | Investigate/apply U.S. geography          |  |  |  |  |  |  |  |  |  | Participate in industrial relations                 |  |  |  |  |  |  |  |  | Interact with people of different races/cultures    |                           |  |  |  |  |  |  |  |  |  |
|                                                          |  |  |  |  |  |  |  |  |  |                                           |  |  |  |  |  |  |  |  |  |                                                     |  |  |  |  |  |  |  |  |                                                     |                           |  |  |  |  |  |  |  |  |  |